RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

Vol. 44 MAY 1945 No. 5

Tomography of the Skull[1]

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THE PURPOSE of this publication is to illustrate in detail the normal anatomical structures of the skull by tomographic roentgenograms. Comparison is made between these serial films and sections of a cadaver head at corresponding levels. In view of the increasing literature on tomography, as well as other methods, *i.e.*, laminagraphy, planigraphy, stratigraphy, etc., this study is necessary for the proper evaluation of roentgen appearances. Only by such a study will it be possible properly to understand and interpret variations from the normal demonstrated by tomography in pathologic states. Especially is this true of cancer.

HISTORY OF TOMOGRAPHY

Body-section roentgenography is a relatively new science, having existed in practical usage since about 1930, gradually but steadily gaining new advocates. Bocage, in 1921, first applied for a French patent embodying the principles of this roentgenographic technic in an attempt to concentrate depth dosage in deep roentgen therapy. Portes and Chausse described a similar method in application for a French patent a few months later. No practical use was made of these mechanisms, however, until Vallebona employed a method using stratigraphic principles. This proved unreliable and unsatisfactory, and in 1933 he developed the stratigraph which approximates closely other methods of body-section radiography in common use today. Ziedses des Plantes, in 1931, described a practical apparatus for body-section roentgenography and stated that he invented the method independently in 1921. Bartelink demonstrated his results with a similar apparatus at a meeting of the Association of Electrology and Roentgenology in Amsterdam.

Jean Kieffer in this country in 1929 patented an apparatus for body-section roentgenography which, with the assistance of Sherwood Moore, was constructed in 1934 and named the laminagraph. The laminagraph antedates the practical devices of Vallebona and Ziedses des Plantes and was probably the first practicable stratigraphic apparatus designed. Grossmann, meanwhile, described an apparatus which he named the tomograph, with which he was able to demonstrate clearly pulmonary abnormalities not well depicted by other radiographic means.

[1] Accepted for publication in June 1944. [2] Now Captain, M.C., A.U.S.

[3] Doctor Anson's contribution consisted of assistance in the identification of the anatomic structures shown in the illustrations.

The literature concerned with skull planigraphy is not extensive, but the works of Epstein, Moore, di Rienzo and Boher, and Froment and Buffé are noteworthy. Much attention, however, has been given to tomography of temporomandibular joint disorders, Peyrus and Aubert first pointing out the significance of this roentgenographic method.

Many authors have published articles concerning pulmonary tomography following Grossmann's pioneer work in 1935. Taylor, in 1938, presented an excellent review of cases seen at the Sea View Hospital.

Body-section roentgenography is especially valuable in examination of the skull, larynx, and thorax. In the former two fields its value is enhanced by ability to compare symmetrical halves as well as to obscure overlying and underlying bony structures which interfere with proper visualization in ordinary roentgenograms. In pulmonary roentgenography, it is often impossible otherwise to isolate pathologic processes because of opacities within the same parenchymal plane or because of superimposition of bony structures of the thoracic cage. In the study of spinal column abnormalities, also, these objections to standard radiographic procedures are eliminated.

Between 1936 and 1940, Leborgne in Uruguay and Canuyt and Gunsett in France demonstrated the value of this procedure in laryngeal cancer. Since then, Moore and his associates and Caulk have contributed to the subject. When Leborgne visited the United States in 1938, he assisted in the design and construction of a tomographic apparatus similar to one he had previously built in Uruguay. To our knowledge, this is the first apparatus of its type in this country. Caulk has adequately described it and again to detail its construction would be superfluous. Because of economy of operation and wide range of use, it is well suited to the needs of small institutions. Its value lies in the ability to obscure from a previously selected plane overlying and underlying bony structures and soft tissues which in the ordinary roentgenogram would interfere with proper visualization of that particular region. While such films do not give distinct and detailed views of osseous architecture, they do furnish information not obtainable by ordinary roentgenography. By such means it is possible to follow a pathologic process from its point of origin to the area where it is lost in normal bony structure, thus obtaining a complete picture of the actual abnormality.

In our work, a cadaver head in relatively good state of preservation was used. This head was placed on the roentgenographic table in the postero-anterior position and, beginning at a point 3.5 cm. from the table top, tomograms were taken at 0.5-cm. levels through the entire skull. In a similar manner, another head was placed in the right lateral and then in the left lateral position and tomograms were taken at 0.5-cm. levels from 3.5 to 10.5 cm. from the table top in both instances. After successful postero-anterior and lateral tomographic films were obtained, the heads were sectioned, the first in the coronal and the second in the lateral planes, in an attempt to duplicate the tomographic levels. Because the saw itself removed some of the tissue in each bite and because there would be marked destruction and maceration of soft tissues in sections of such thin dimension, it was considered advisable to obtain the sections at approximately 2-cm. levels. In this way, comparisons could be made of the tomographic films which most closely approximated the anatomical levels obtained. Comparison of the coronal levels was made to a point just beyond the sphenoid sinuses, since it was found that for our purpose the films beyond this plane did not disclose anatomic structures of enough significance to justify detailed description. In addition, pathologic states within the cranial vault beyond this level could be isolated and visualized better by ordinary roentgenographic means than by postero-anterior tomography. Lateral tomography, however, does give valuable information concerning intracranial lesions.

In our tomographic descriptions we have attempted to use bony landmarks of the skull easy of identification, so that duplication of levels would be avoided as much as possible. In the postero-anterior projection, therefore, the fixed upper alveolar ridge is first used as an identifying structure; later, when sections beyond this level are visualized, the zygomatic arch and temporomandibular joint serve as guides. Since we cannot completely obscure the structures above and below our plane of tomographic motion, a certain thickness of tissues is included in each tomographic section so that in adjacent films it is possible to visualize structures which anatomically are located at a level above or below such plane. In such instances, however, these structures are not in critical focus and do not interfere appreciably with the proper evaluation of findings.

The radiographic factors for postero-anterior tomograms were as follows: kv.p. 65.2 to 74.2; 100 ma.; distance 40 inches; time 2 seconds; kv.p. increasing in inverse proportion to the distance from the table top. The following were the factors for the lateral tomograms: kv.p. 58.0 to 65.2; 100 ma.; distance 40 inches; time 2 seconds; kv.p. increasing as in postero-anterior tomography.

It may be stated that considerable variations in technic were attempted before the factors were found which best suited our needs. Also, because of the density of living tissue, the above factors must be varied slightly for diagnostic and radiographic usage. In our experience, elevation of the kv.p. has proved sufficient for obtaining good diagnostic films.

We wish here to thank Dr. James Irwin[4] for his aid in securing the factors of the radiographic technic.

INDEX OF LABELS

1. Alveolar process of maxilla
2. Maxillary sinuses
3. Orbit
4. Intramaxillary septum
5. "H" line
6. "R" line
7. Inferior concha
8. Ethmoidal air cells
9. Perpendicular plate of ethmoid
10. Nasal septum
11. Frontal sinuses
12. Supraorbital sinuses
13. Roof of orbit
14. Frontal process of zygoma
15. Zygomatic process of frontal bone
16. Middle concha
17. Zygomatic arch
18. Crista galli
19. Canine eminence of maxilla
20. Ascending ramus of the mandible
21. Palatine process of the maxilla
22. Lamina papyracea
23. Cribriform plate
24. Ostium of supraorbital sinus
25. Posterior ethmoidal air cells
26. Superior orbital fissure
27. Floor of infraorbital canal
28. Tongue
29. Inferior orbital wall
30. Infraorbital canal
31. Upper alveolar ridge
32. Coronoid process of mandible
33. Perpendicular plate of vomer
34. Osseous floor of anterior cranial fossa
35. Inferior orbital fissure
36. Palatine bone
37. Sphenoid sinus
38. Spur of sphenoid
39. Septum of sphenoid sinus
40. Greater wing of sphenoid
41. Styloid process
42. Optic foramen
43. Lesser wing of sphenoid bone
44. Condyloid process of the mandible
45. Neck of condyloid process of mandible
46. Superior concha
47. Temporomandibular joint
48. Angle of mandible
49. Mastoid process
50. Squamous portion of temporal bone
51. Parietal bone
52. Zygoma
53. Maxilla
54. Tubercle at the root of zygomatic process of temporal bone (marginal tubercle of zygoma)
55. Mandibular notch
56. Middle cranial fossa
57. Petrous portion of temporal bone
58. Linear shadow cast by curving surface of zygoma
59. Zygomatico-frontal suture line
60. Posterolateral orbital wall
61. Anterior cranial fossa (34)
62. Posterior cranial fossa
63. Auditory canal
64. Cerebellum

[4] Trainee, National Cancer Institute.

65. Tentorium cerebelli
66. Orbital plate of maxilla
67. Anterior clinoid process
68. Spine of sphenoid bone
69. Occiput
70. Lateral pterygoid plate
71. Premaxilla[5]
72. Pterygo-maxillary fissure
73. Body of sphenoid bone
74. Medial pterygoid plate
75. Horizontal plate of palatine bone
76. Soft palate
77. Sella turcica
78. Dorsum sellae
79. Palatine process of maxillary bone
80. Perpendicular plate of palatine bone
81. Basi-occiput
82. Foramen magnum
83. Uvula
84. Nasal bone
85. Spinal cord
86. Laryngeal part of pharynx (hypopharynx)
87. Nasopharynx
A. Falx cerebri
B. Air in ventricle

POSTERO-ANTERIOR ANATOMICO-TOMOGRAPHIC STUDY

The following is a detailed description of the postero-anterior tomographic levels of the skull. For the views which most closely approximate the anatomical sections, the latter are inserted for comparison of anatomic landmarks visible on both. By such comparison it is possible to determine how correct we are in the evaluation of roentgen shadows in tomography. Changes in the morphology, as well as appearance of structures as they appear in focal view, will be noted.

Figure 1 is a tomogram at the level of the upper central incisor teeth. The lower central and lateral incisors are also in good focus, and the line of the symphysis menti is shown. The depression in the left mandible at the mental foramen is also seen, as is the left mandibular ramus. The alveolar process of the maxilla, 1, is represented by the most dense shadow on this film. Both maxillary sinuses, 2, are just coming into view. They are seen as small areas of rather indefinite outline impinging on the medial and inferior walls of each orbit, 3. Septa, 4, are clearly depicted within both of these atria.

In this film a vertical linear shadow is apparent, arising from the lateral border of each maxilla and extending superiorly to bisect each maxillary sinus. This density, noted in a previous publication, represents a shadow cast by the posterolateral wall of the maxilla and is arbitrarily called the "H" line, 5. This linear shadow, as will be seen in later tomograms, continues cephalad and medially to form the inferior border of the inferior orbital fissure. At such level, the "H" line represents the point of junction of the posterolateral wall and the orbital plate of the maxillary bone. A similar shadow just appearing in view behind the lateral third of the right orbit is cast by the lateral portion of the frontal bone, squamous portion of the temporal bone, and in most part by the greater wing of the sphenoid bone. This line has been arbitrarily called the "R" line, 6. In later films we note that this line curves abruptly medially and upward to parallel the "H" line and form the superior border of the inferior orbital fissure. At this level the "R" line represents the line of junction between the greater wing of sphenoid and the orbital plate of that bone. At such levels, therefore, these lines are both more apparent and important.

The nasal cavity is clearly outlined, and the inferior conchae, 7, are just coming into view, delineating a clear inferior meatus. The middle conchae are not yet seen, but several anterior ethmoid air cells, 8, can be visualized, as well as the perpendicular plate of the ethmoid bone, 9. The nasal septum, 10, is in good focus. Both orbital cavities, 3, are well outlined and are large and elliptical. It is possible to see the superimposed soft-tissue shadows of both upper and lower eyelids.

The faint representations of the frontal sinuses, 11, are fading from view, since the tomographic level is beyond these air cells. The supraorbital sinuses, 12, however, are clearly outlined. Embryologically these cells are a lateral projection of the anterior and middle ethmoid cells and pneumatize

[5] Cunningham's Textbook of Anatomy. Oxford University Press, Seventh Edition, 1937, p. 218.

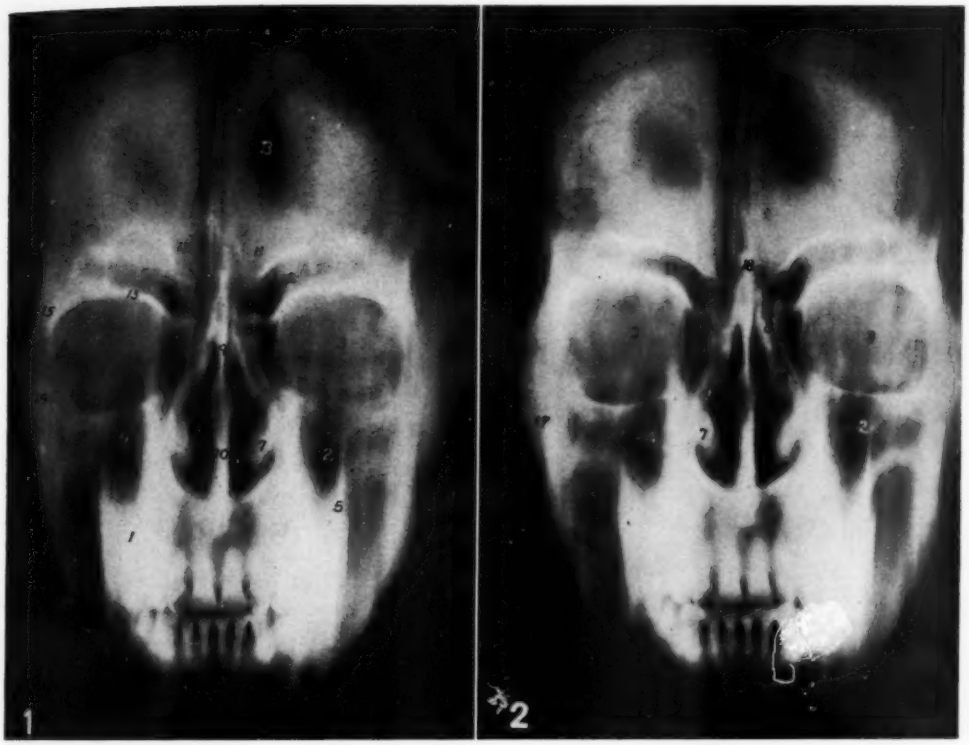


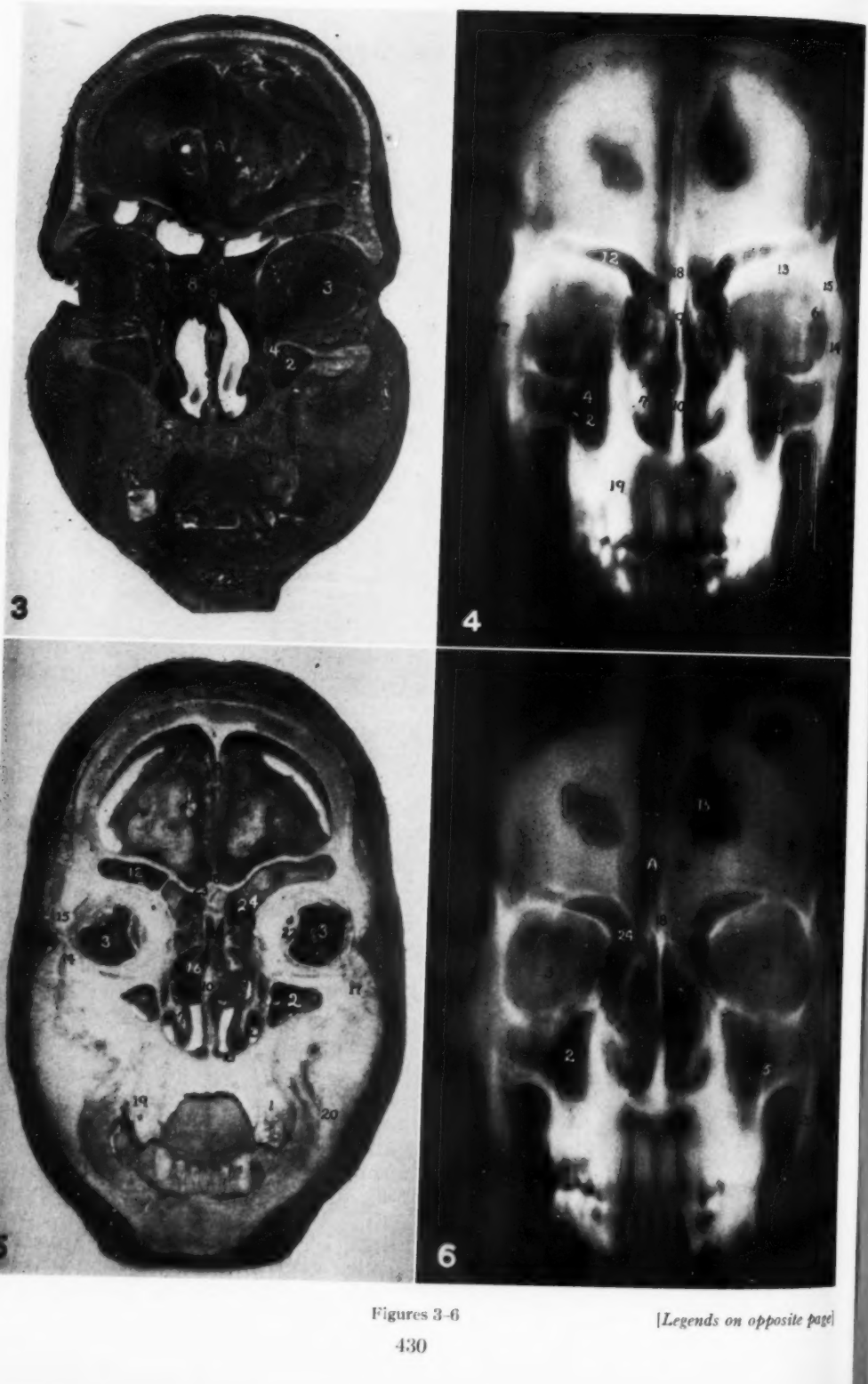
Fig. 1. Coronal section at level of upper central incisor teeth. 1. Alveolar process of maxilla. 2. Maxillary sinus. 3. Orbit. 4. Intramaxillary septum. 5. "H" line. 6. "R" line. 7. Inferior concha. 8. Ethmoidal air cells. 9. Perpendicular plate of ethmoid. 10. Nasal septum. 11. Frontal sinuses. 12. Supraorbital sinuses. 13. Roof of orbit. 14. Frontal process of zygoma. 15. Zygomatic process of frontal bone. A. Falx cerebri. B. Air in ventricle.

Fig. 2. Coronal section at level of upper lateral incisor teeth. 16. Middle concha. 17. Zygomatic arch. 18. Crista galli.

that portion of the frontal bone just posterior to the frontal sinuses and overlying the orbit. Anatomically this explanation is debatable. It is the opinion of some anatomists that, while in the majority of instances the above holds true, there are many examples in which these supraorbital cells quite definitely represent a posterior pneumatization of frontal and sometimes anterior sphenoid bones by the frontal sinus. (Poor results in surgical procedures upon the frontal sinuses are frequently attributed by rhinologists to these cells, because of their inaccessibility and drainage through parent structures, in the case of ethmoid pneumatization.) The roof of each orbit, 13, lying between the orbital cavity and the supraorbital sinus is particularly well seen. The thin wall between these structures is manifest. The frontal process of the zygoma, 14, and its junction with the zygomatic process of the frontal bone, 15, is clear, especially on the right.

Because the skull is that of a cadaver, it had been exposed for some time to air and had lost much of its fluid content. We are therefore able to delineate the anterior cornua of both lateral ventricles, B, the falx cerebri, A, and actual brain substance. (These structures are ordinarily not demonstrable by this radiographic technic.)

The next tomographic level, Figure 2, is at the plane of the upper lateral incisor teeth. Here the inferior conchae, 7, are



Figures 3–6

[*Legends on opposite page*]

clearer and larger, and the origins of the middle conchae, 16, are just visible. The maxillary atria, 2, are more definite and triangular, and pneumatization of the zygomatic arch of the maxilla of either side is discernible. Septa, 4, are very clear within these cells. The inferior border of the zygomatic arch, 17, is coming into relief. The orbital cavities, 3, are slightly larger than in the previous tomogram and slightly more spherical in outline. The ethmoid sinuses, 8, bilaterally are in clearer detail, and the supraorbital cells, 12, are in better focus and their lateral extension is demonstrable. The crista galli, 18, is visible. The "H" and "R" lines show no great variation from Figure 1. No other significant changes in the osseous structure are noted.

Figures 3 and 4 are of relatively comparable anatomic and tomographic levels, although the former is slightly anterior to the roentgenographic plane and is really a composite of the second and third tomographic levels. The roentgenogram and anatomic cuts are at the level of the canine teeth bilaterally and define the canine eminence of the maxilla, 19, well. The section is at the most prominent portion of the inferior conchae, 7, and the tomogram reveals a slight increase in size of the shadow of the middle concha, 16, although this structure is absent in the specimen.

At the anatomic level, the maxillary sinuses, 2, are still triangular, even though in the tomogram they assume a more rhomboidal configuration. Orbits, 3, in both views are large and spherical; the nasal septum, 10, is well delineated, as are the ethmoid air cells, 8. The supraorbital sinuses, 12, are in sharp focus and their form is almost duplicated in the two views. The margins of the orbital roofs, 13, so clearly visualized in Figure 2, are now blurring because of the curvature of the superior orbital plates. Since the "H" and "R" lines represent osseous planes accentuated by tomographic technic, they are not directly applicable to the anatomic sections. In the roentgenogram they are noted in clearer detail than previously, especially on the left side.

As Figure 3 represents an anatomic level just beyond the second, and anterior to the third tomographic plane, so Figure 5 represents an anatomic level just posterior to the latter plane, disclosing comparable anatomic structures. The configuration of the maxillary, supraorbital, and ethmoid sinuses is similar, the orbital cavities are of size and shape corresponding to the tomographic level shown in Figure 4, and the limiting walls of both maxillary antra are distinct and comparable. As in the tomogram, the most anterior portion of the middle concha is making its appearance. The inferior conchae and the septum are distinct and conspicuous.

In Figure 6, we are now 5 cm. from the roentgenographic table top. This tomogram is at the level of the first bicuspid teeth bilaterally. Both maxillary sinuses, 2, are excellently defined, the lateral pneumatization of the zygomatic arches being particularly well delineated. The walls of the sinuses appear in sharp detail, and the orbital and inferior maxillary osseous structures are well demonstrated. At this level the ascending rami of the mandible, 20, are seen. The inferior conchae, 7, are still well defined and the downward projections of both middle conchae, 16, can be visualized. The palatine processes of the maxillae, 21, are also well seen. At

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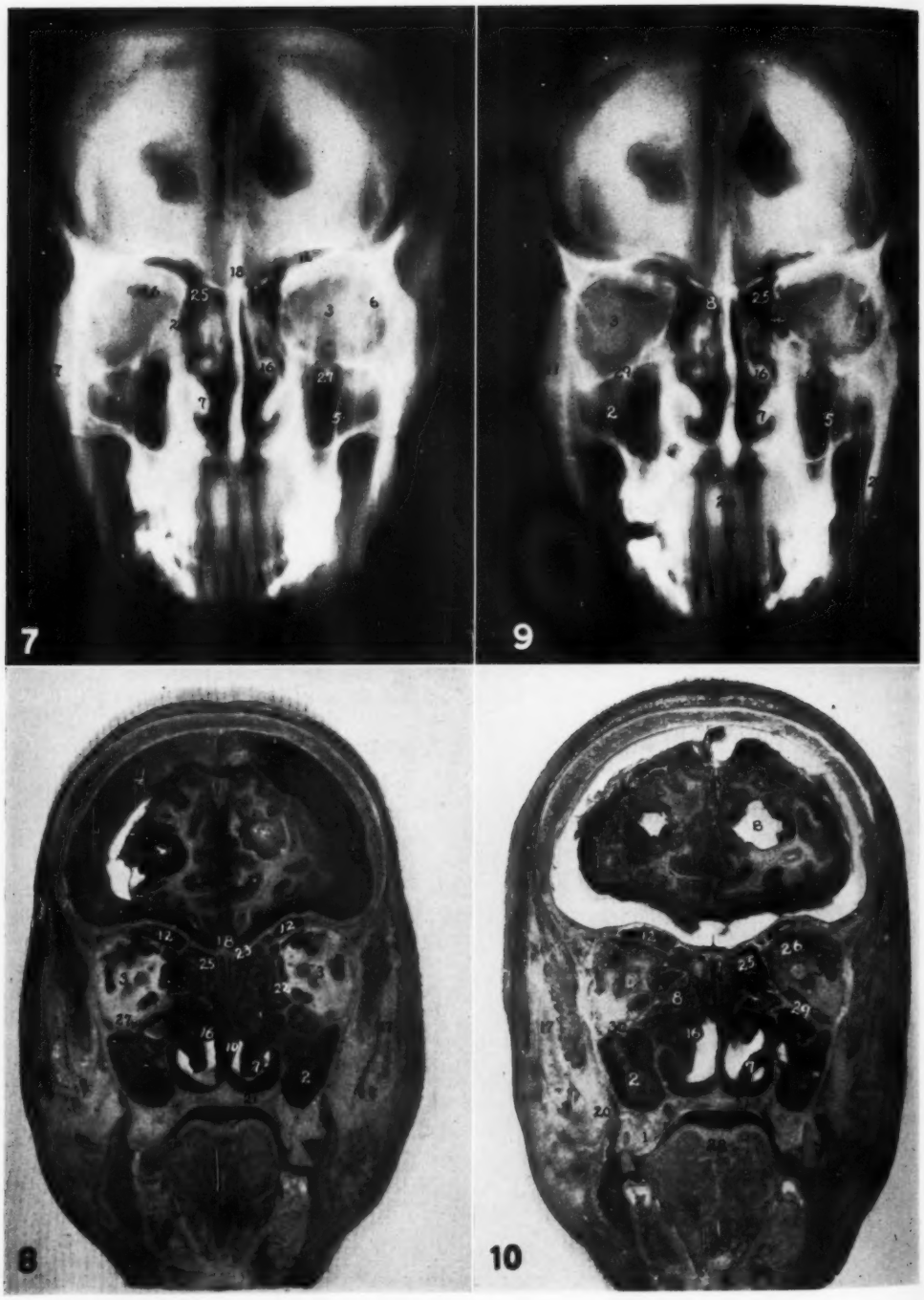
Fig. 3. Anatomic coronal section at level of upper canine teeth. 2. Maxillary sinus. 3. Orbit. 7. Inferior concha. 8. Ethmoidal air cells. 10. Nasal septum. 12. Supraorbital sinus. 13. Roof of orbit. 19. Canine eminence of maxilla.

Fig. 4. Coronal section at level of upper canine teeth. 19. Canine eminence of maxilla. "H" and "R" lines are in clearer detail, especially on the left side (5 and 6).

Fig. 5. Anatomic coronal section at level of upper first bicuspid teeth. 2. Maxillary sinus. 3. Orbital cavities. 7. Inferior concha. 8. Ethmoidal air cells. 12. Supraorbital sinuses. 16. Middle concha. 18. Crista galli. 20. Ascending ramus of mandible. 21. Palatine process of maxilla. 22. Lamina papyracea. 23. Cribriform plate. 24. Ostium of supraorbital sinus. A. Falx cerebri. B. Air in ventricle.

Fig. 6. Coronal section at level of upper first bicuspid teeth. 20. Ascending ramus of mandible. 21. Palatine process of maxilla. 22. Lamina papyracea. 23. Cribriform plate. 24. Ostium of supraorbital sinus.



Figures 7–10

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this plane the orbital cavities, 3, appear slightly smaller than in previous tomograms but are more spherical in outline. The lamina papyracea, 22, of the medial orbital wall, laterally bounding the ethmoidal air cells, 8, is seen in distinct detail. The ethmoidal sinuses, 8, are in good focus and the cribriform plate, 23, is shown. The crista galli, 18, is fading from view. The supraorbital sinuses, 12, are now smaller than in previous views and do not extend so far laterally. What is probably an orifice, 24, from these sinuses into the ethmoid cells is seen on either side. The falx cerebri, A, and the air-filled anterior horns, B, of both lateral ventricles are well defined. The "H" and "R" lines are becoming more prominent and are gradually and progressively approximating each other. This is especially obvious on the left side.

Figures 7 and 8 represent corresponding roentgenographic and anatomic levels. Certain changes in the shape of structures previously observed are apparent. The level of these "sections" is at the approximate coronal plane of the second bicuspid bilaterally. The crista galli, 18, is fading from view, and the cribriform plate, 23, of the ethmoid is very distinct. The supraorbital sinuses, 12, are smaller and narrower and we are now beginning to see the posterior ethmoid air cells, 25. The middle nasal conchae, 16, are very well delineated, while the inferior conchae, 7, are receding from sharp focus. The orbital cavities, 3, are becoming smaller and assuming a triangular shape. The lamina papyracea, 22, is still fairly well defined on the left side on the tomographic view. The beginning of the superior orbital fissure, 26, is seen in the superior portion of the right orbit on this film. The inferior orbital fissure in our study has never been well shown by posterior-anterior tomography. The maxillary sinuses, 2, are smaller at this level and becoming triangular. In the superior portion of each of these atria is a small, wedge-shaped projection directed at the lumen of the sinus. It is felt that these osseous structures in the roentgenograms represent the floors of each of the infraorbital canals, 27. The inferior wall of each maxilla is distinct to view, and its projection into the zygoma is demonstrated, as well as the clearly evident border of the lateral zygomatic arch, 17. The "H" and "R" lines in the roentgenogram are approximating each other more closely on the left side and are more clearly visualized on the right side of the skull.

Figure 9 shows the next tomographic level, at the plane of the alveolar ridge between the bicuspid and first molar teeth, and Figure 10 represents approximately the same anatomic level of the sectioned skull. While it is possible to distinguish the beginning appearance of tongue substance, 28, in Figure 7, it is in this tomographic film (Fig. 9) that its outline is definite and well formed. The ascending ramus of the mandible, 20, on the left is still visible on the roentgenogram. The maxillary sinuses, 2, are smaller than on the previous roentgenogram, but their medial portions are elongated; they extend upward to the level of the middle ethmoid air cells, 8, and their excursion inferiorly carries them well into the alveolar ridge. The lateral extension of both atria into zygomatic arch, 17, is not so pronounced. The thin wall of the orbit inferiorly, 29, is well defined in both sections. (It is easy to understand, from these views why interorbital

Fig. 7. Coronal section at level of upper second bicuspid teeth. 25. Posterior ethmoidal air cells. 26. Superior orbital fissure. 27. Floor of infraorbital canal.

Fig. 8. Anatomic coronal section at level of second bicuspid teeth. 2. Maxillary sinus. 3. Orbital cavities. 12. Supraorbital sinuses. 16. Middle concha. 17. Zygomatic arch. 18. Crista galli. 22. Lamina papyracea. 23. Cribriform plate. 25. Posterior ethmoidal air cells. 26. Superior orbital fissure. 27. Floor of infraorbital canal.

Fig. 9. Coronal section at level of upper alveolar ridge between bicuspid and first molar teeth. 28. Tongue. 29. Inferior orbital wall. 30. Infraorbital canal.

Fig. 10. Anatomic coronal section at level of upper alveolar ridge between bicuspid and first molar teeth. 2. Maxillary sinus. 3. Orbit. 7. Inferior concha. 8. Ethmoidal air cells. 12. Supraorbital sinus. 16. Middle concha. 17. Zygomatic arch. 20. Ascending ramus of mandible. 25. Posterior ethmoidal air cells. 26. Superior orbital fissure. 28. Tongue. 29. Inferior orbital wall. 30. Infraorbital canal.

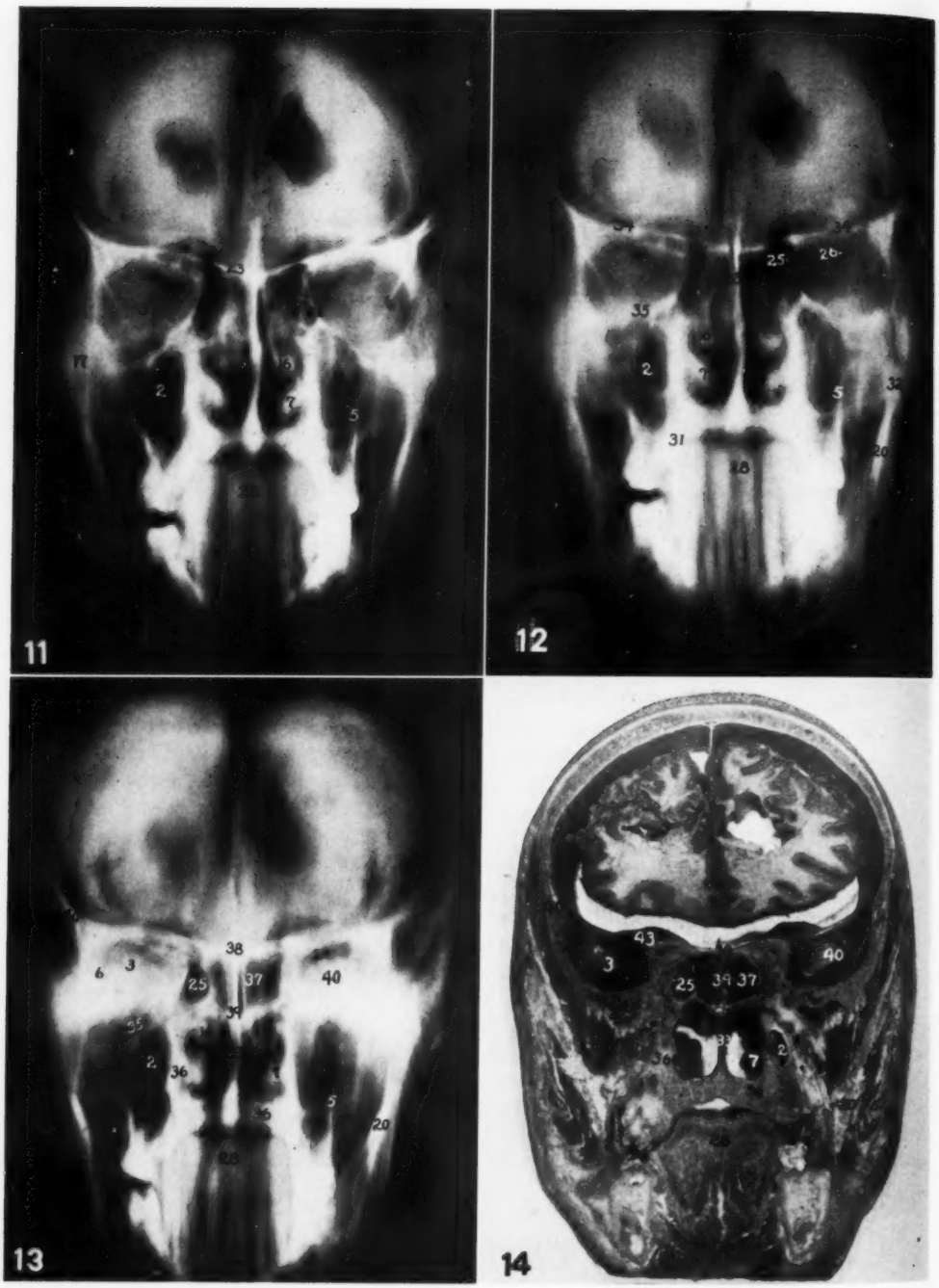

Fig. 11. Coronal section at level of first upper molar teeth.

Fig. 12. Coronal section at level of second upper molar teeth. 31. Upper alveolar ridge. 32. Coronoid process of mandible. 33. Perpendicular plate of vomer. 34. Osseous floor of anterior cranial fossa. 35. Inferior orbital fissure.

[*Legends cont. on opposite page*]

extension of antral cancer is not an infrequent occurrence.) The infraorbital canals, 30, are both visualized in the tomogram, while that on the right side is seen in the anatomic section. Both inferior, 7, and middle conchae, 16, are excellently detailed, the latter being more prominent than in any previous film.

The orbital cavities, 3, are smaller and less spherical, assuming a pyramidal shape, their bases being directed medially and inferiorly. The ethmoid sinuses, 8, are well depicted, both middle and posterior cells, 25, appearing in view in Figures 9 and 10. The supraorbital sinuses, 12, are still smaller, that on the left being almost completely beyond the tomographic level. Good duplication of these structures is noted in the anatomic view. The crista galli is barely visible in both views. Both superior orbital fissures, 26, are seen. The brain substance and lateral ventricles are also shown. The "H" and "R" lines, 5 and 6, are very prominent on the left and quite well seen on the right side of the skull. Medial and superior curvature of the "R" line to form the superior border of the inferior orbital fissure is seen.

In Figure 11, the next tomographic level, we are at the coronal plane of the first upper molar tooth. Tongue substance, 28, is well defined and, in the nasal cavity, inferior, 7, and medial conchae, 16, are receding from focus. This level is through the posterior portion of both maxillary antra, 2, and the pneumatization of zygomatic arch, 17, is less evident than in previous films. The margins of maxillary and zygomatic bones inferiorly and laterally are less distinct. The maxillary sinus, 2, on the right is small and circular, while that on the left is narrow and elongated from above downward. Within the nasal cavity the middle, 16, and inferior conchae, 7, are smaller. The ethmoidal sinuses are well demonstrated, and the posterior cells, 25, of this structure are in clearer detail and are larger. The supraorbital sinus, 12, on the left has completely disappeared, while on the right there is a remnant of the large well-formed structure seen previously. The cribriform plate, 23, of the ethmoid is still in view.

The orbital cavities, 3, are smaller and almost triangular. The lamina papyracea, 22, is still well seen. The superior orbital fissure, 26, on each side is excellently detailed. The curvature of each greater wing of the sphenoid bone, which forms the walls of both the superior and inferior orbital fissures, is noted bilaterally. The "H" and "R" lines appear well defined and are approximating each other on the left side.

Figure 12, the next tomographic level, is approximately at the plane of the second upper molar tooth. The tongue, 28, is well defined, as are the upper alveolar ridges, 31, bilaterally. The ascending ramus, 20, of the left mandible is visualized, as is its coronoid process, 32. Both maxillary sinuses, 2, are small, and that of the left side of the skull is assuming a spherical outline. The conchae bilaterally are smaller, and the middle ethmoid air cells are being lost to view, while the posterior ethmoid sinuses, 25 (larger and more clearly defined cavities than either anterior or middle groups), are becoming more prominent. The anterior portion of the vomer (perpendicular plate), 33, is now visualized at the superior portion of the nasal septum. The remnant of the right supraorbital sinus, 12, is still seen. The orbital cavities 3, are still triangular, but narrow and elongated horizontally. The osseous floor of the anterior cranial fossa, 34, is well seen, and a tiny spur of the crista galli remains in view. Superior, 26, and inferior, 35, orbital fissures are observed bilaterally, especially the former, and it is possible to

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Fig. 13. Coronal section at level of last upper molar teeth. 36. Palatine bone. 37. Sphenoid sinus. 38. Spur of sphenoid. 39. Septum of sphenoid sinus. 40. Greater wing of sphenoid.

Fig. 14. Anatomic coronal section at level of last upper molar teeth. 2. Maxillary sinus. 3. Orbital cavity. 7. Inferior concha. 16. Middle concha. 20. Ascending ramus of mandible. 25. Posterior ethmoidal air cells. 28. Tongue. 33. Perpendicular plate of vomer. 36. Palatine bone. 37. Sphenoid sinus. 38. Spur of sphenoid. 39. Septum of sphenoid sinus. 40. Greater wing of sphenoid bone. 43. Lesser wing of sphenoid bone.

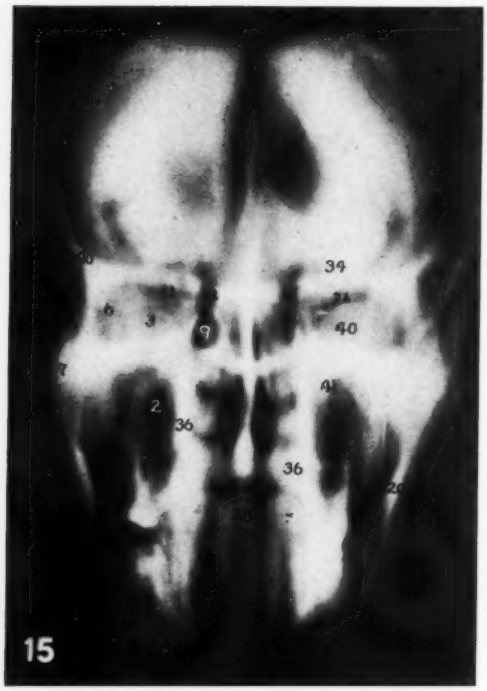


Fig. 15. Coronal section at level of posterior portion of last molar tooth. 41. Styloid process. 42. Optic foramen. 43. Lesser wing of sphenoid bone.

demonstrate the medial and superior curvature of the "R" line, 6, bilaterally, forming the roof of the latter fissure.

In Figures 13 and 14 the coronal plane is at the last upper molar level. The ascending ramus, 20, of the left mandible is still shown on the tomogram, but the coronoid process is not in focus. Palatine bones, 36, are evident in both views, and it is possible to see that they do not quite reach the mid-line in the roentgen film. Because it is impossible to obscure adjacent structures completely, we see remnants of the maxillary sinuses, 2, bilaterally in the tomogram, while a small portion of the left antrum is apparent in the anatomic section. The posterior portion of middle, 16, and inferior conchae, 7, are almost duplicated in these views, as well as the mid-portion of the vomer, 33. The septal cartilage is well seen. At this level we have our first view of the sphenoid sinuses, 37, all the walls of which are clear. (In this particular skull, an anomalous posterior ethmoid cell, 25, on the right compresses the sphenoid cell on that side. This is not a rare occurrence, and at times such an anomalous sinus may almost completely replace the sphenoid cell posterior to it by posterior expansion and pneumatization.) A tiny spur, 38, on the sphenoidal crest is noted in the anatomical and roentgen views. The septum of the sphenoid sinus, 39, as well as the wall forming the nasal roof, is well depicted. The supraorbital sinuses, except for an almost negligible remnant on the right side, have disappeared from view. The orbital cavities, 3, at this level are narrow and elongated horizontally. In both figures it is possible to distinguish the superior orbital fissures, 26. The inferior orbital fissure, 35, is fairly visualized in the tomogram. Also in this roentgenogram the "H," 5, and "R," 6, lines are clear and on the left side we are able to trace them both as they proceed medially and upward to bound the inferior orbital fissure. This delineation is not so clear on the opposite side of the skull. The curvature of the greater wing of the sphenoid, 40, is noted on both sides as it forms the boundary of separation between these fissures. The lesser wings of the sphenoid, 43, are better seen in the anatomical section than in the tomogram.

The next tomographic view, Figure 15, is at the level of the posterior portion of the last molar tooth of the right upper alveolar ridge. On the left side of the skull we are slightly beyond this level. Tongue, 28, substance is still visible, and the palatine bone, 36, is seen bilaterally. This section is beyond the level of the maxillary sinus, 2, on the left side and only a small circular remnant of that on the right side of the skull is noted. The inferior and middle conchae are still demonstrable, but they, too, are receding from focus. On the left side of the skull the tip of the styloid process, 41, is making its appearance, between the ascending ramus, 20, of the mandible and the lateral wall of the maxilla. Both orbital cavities are flattening and, although the superior orbital fissures can still be seen,

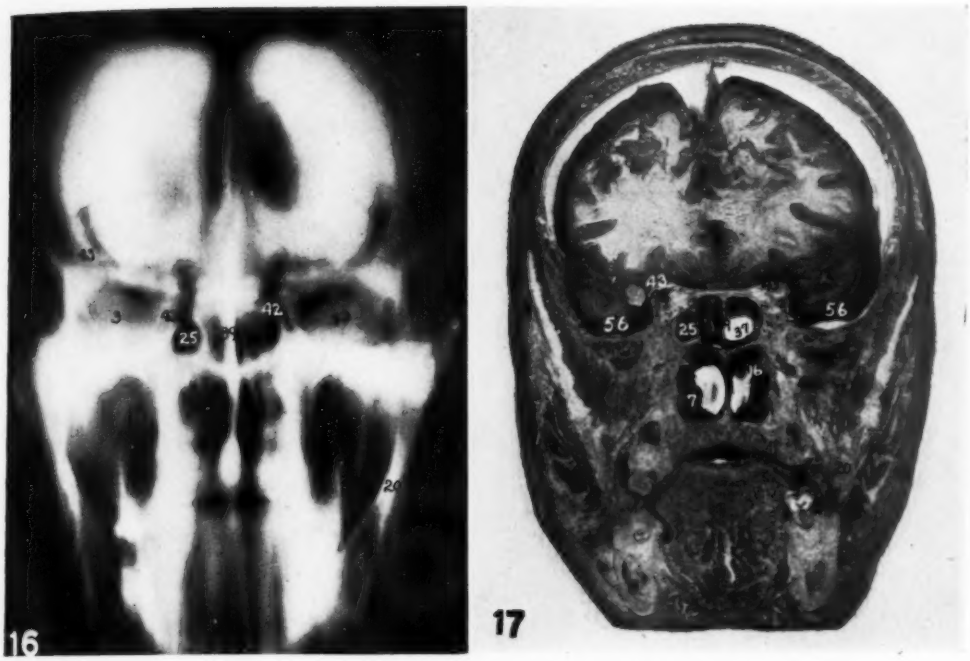


Fig. 16. Coronal section at level of most posterior portion of upper alveolar ridge.
Fig. 17. Anatomic coronal section at level of the most posterior portion of the upper alveolar ridge. 7. Inferior concha. 16. Middle concha. 17. Zygomatic arch. 20. Ascending ramus of mandible. 25. Posterior ethmoidal air cell. 37. Sphenoid sinus. 42. Optic foramen. 43. Lesser wing of sphenoid bone. 56. Middle cranial fossa.

the "H" and "R" lines are becoming less prominent, and the inferior orbital fissure is out of focus.

The sphenoid sinus is well delineated and the anomalous right posterior ethmoid cell, 25 (erroneously numbered 9 in the figure), is very clear. Just above the lateral edges of each sphenoid sinus we are now able to visualize the optic foramina, 42. Both greater, 40, and lesser wings, 43, of the sphenoid are seen and the floor of the anterior cranial fossa, 34, is shown. The prominent spread of the zygomatic arch, 17, on both the right and the left side is becoming evident.

In Figures 16 and 17, comparable tomographic and anatomic views, the coronal plane is at the level of the most posterior portion of the upper alveolar ridge bilaterally, that on the right side including the last portion of the third molar tooth. This level also includes, in this particular skull, the most posterior portion of the lower alveolar ridge, at the level of the last molars. On the tomographic film it is possible to distinguish the ascending rami, 20, of both mandibles as they are coming into view. In this film, also, we can see the small remnant of the right maxillary sinus as well as the fading shadow of that on the left. In the anatomic section, we are beyond this osseous level. (The angle at which the anatomic sections were cut does not exactly coincide with the tomographic levels, so that, as we proceed superiorly, the anatomic sections are deeper than those seen stratigraphically. This difference in level is more apparent as we approach the plane of the lesser wing, 43, of the sphenoid and proceed just beyond it into the middle cranial fossa, 56.) In both views, however, we notice the remnants of both the middle, 16, and inferior conchae, 7. The sections are now beyond the midportion of the sphenoid sinuses, 37, and the walls are slightly blurred due to the curva-

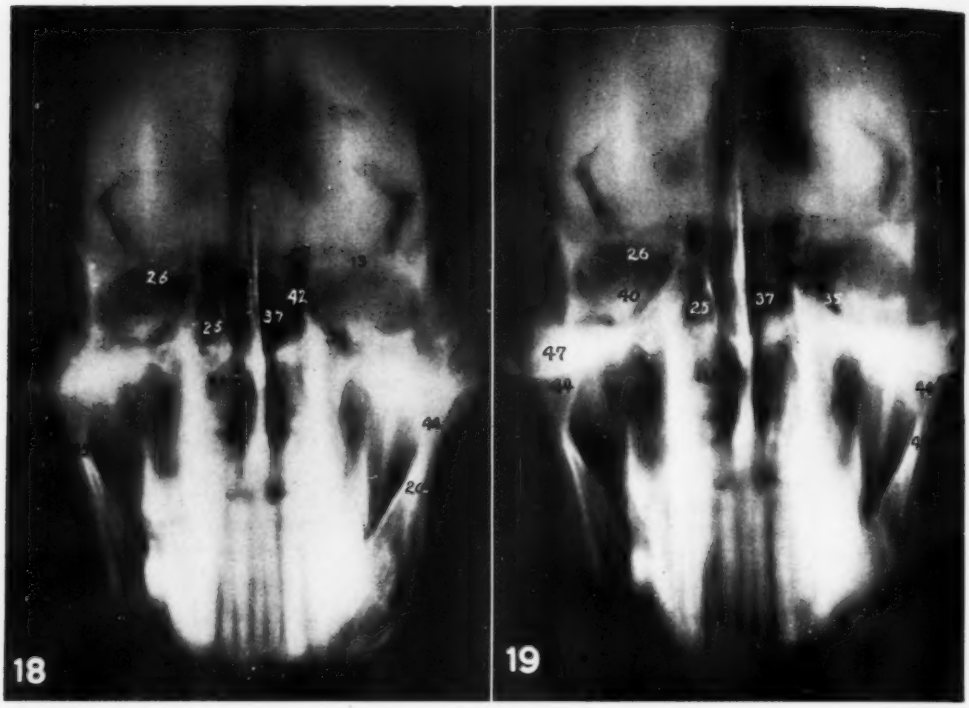


Fig. 18. Coronal section at level of mid-portion of zygomatic arch. 44. Condyloid process of mandible. 45. Neck of condyloid process of mandible. 46. Superior concha.
Fig. 19. Coronal section at level of widest portion of zygomatic arch. 17. Zygomatic arch. 44. Condyloid process of the mandible. 47. Temporomandibular joint.

ture of the posterior osseous limits. The posterior ethmoid cell, 25, on the right is still in excellent view. The optic foramen, 42, can be seen only on the right side in the anatomical section, while both foramina, 42, are seen on the tomogram. In the latter, also, we are able to note the lesser wings, 43, of the sphenoid bounding the superior portion of the orbital cavities, 3, which are small, flat, and transverse. In the anatomic section we are behind the orbital cavity and portions of the temporal lobe of the brain are seen. The "H" and "R" lines of the roentgenogram are indistinct and disappearing. The zygomatic arches, 17, are still more prominent on this tomogram than they have been on previous films.

Figure 18 is at the level of the mid-portion of the zygomatic arch and is beyond any bony landmarks of the upper alveolar ridge. Both ascending rami, 20, are in good focus, and the condyles, 44, of these structures are beginning to take form. The neck, 45, of this structure is well seen. Both maxillary antra are now lost to view, and the inferior border of the zygomatic arch, 17, is in fair detail as it curves to meet the maxilla on each side. The nasal cavity is smaller at this level, and the superior nasal conchae, 46, are faintly visible. (Because of the posterior and inferior angulation of all the conchae at this level, these structures cast roentgenographic shadows which seem to coalesce.) The orbital cavities as such are no longer demonstrable, but the greater wings, 40, of the sphenoid are well depicted, especially on the right, and both superior, 26, and inferior orbital fissures, 35, can be seen. The faint shadow of the roof of the orbit, 13, is still visible. The sphenoid sinus, 37, anomalous ethmoid

cell, 25, on the right, and optic foramina, 42, can still be identified. The "H" and "R" lines are no longer visible.

The last postero-anterior tomogram shown, Figure 19, is at the widest (most lateral) portion of the zygomatic arch in the skull. At this level we are 9.5 cm. from the roentgenographic table top. The neck of the condyloid process, 45, on each side is in sharp focus, and the condyles, 44, are being visualized. The temporomandibular joint, 47, is coming into view on the right side. The zygomatic arch, 17, is well seen, and the lateral border is fairly well focused. The inferior edge of the arch is in clear detail, as is its junction with the maxilla on each side. In the nasal chamber it is now possible to distinguish the inferior, middle, and superior, 46, conchae on the right. The remnants of both sphenoid sinus, 37, and posterior ethmoid cell, 25, on the right are seen, as well as the remnant of the optic foramen, 42, on the right. The greater wing of the sphenoid, 40, is receding from critical focus, as are the orbital fissures, 26 and 35, and lesser wing of the sphenoid.

LATERAL TOMOGRAPHY

The lateral tomograms pictured here were secured from the same head as the postero-anterior roentgenograms. The anatomic sections, however, were obtained from a second head after the tomograms had been printed. Because anatomic landmarks are the same in both series, comparison is now made of the corresponding sections and tomographic views. One point of difference is noted in comparison. The anatomic views are of a skull in which there are no upper teeth, while in the tomographically sectioned skull most of the upper teeth are present. The bony landmarks selected as planes of lateral sectioning are the zygomatic arch, mastoid process, and the mandible. Although the latter is not a fixed structure, its deviation laterally is an uncommon occurrence, and it is felt that anatomic variations in width of the mandibular arch are of such slight proportions that the levels selected in our series are applicable to the great majority of individuals.

Figure 20 is the first lateral tomogram in this series, and Figure 21 is the anatomic section to which it most closely corresponds. These sections are at the level of the tubercle of the root of the zygomatic process of the temporal bone, 54. The shadow of the condyle of the mandible, 44, is quite visible in the tomogram and a portion of the condyle is apparent in the anatomic view. The latter delineates the external auditory canal, 63, well, but this structure is not well demonstrated on the tomogram. The angle of the mandible, 48, is well seen on the roentgenographic film. The most lateral portion of the mastoid process, 49, of the temporal bone is also shown. The anatomic level bisects the squamous portion of the temporal bone, 50, and the parietal bone, 51, as well. The roentgenogram does not disclose these structures so clearly, but they can be identified. The zygoma, 52, is seen in both views, and in the roentgenogram it is possible to distinguish the underlying maxilla, 53, and maxillary sinus, 2, which appear in more critical view in deeper films. The frontal process of the zygoma, 14, is seen in this film, and its curvature to form the lateral wall of the orbit, 3, is also visualized. The marginal tubercle of the zygoma, 54, can be identified. Other structures are faintly but not clearly seen.

Figure 22, the next tomogram, is at the level of the tip of the mastoid process. The angle of the mandible, 48, and condyle, 44, are more pronounced, and the coronoid process, 32, is faintly seen. The mastoid process, 49, and its air cells are in clear detail. The mandibular notch, 55, and the tubercle, 54, at the root of the zygomatic process are shown, but the zygomatic arch, 17, is disappearing. The zygoma, 52, is in good focus and its sutural juncture, 59, with the frontal bone is clearly visualized. The heavy linear shadow cast by the curving anterolateral surface of the zygoma, 58, extending superiorly to join the zygomatic process of the frontal bone, as in the previous tomogram, is seen overlying the maxillary sinus, 2, which is still

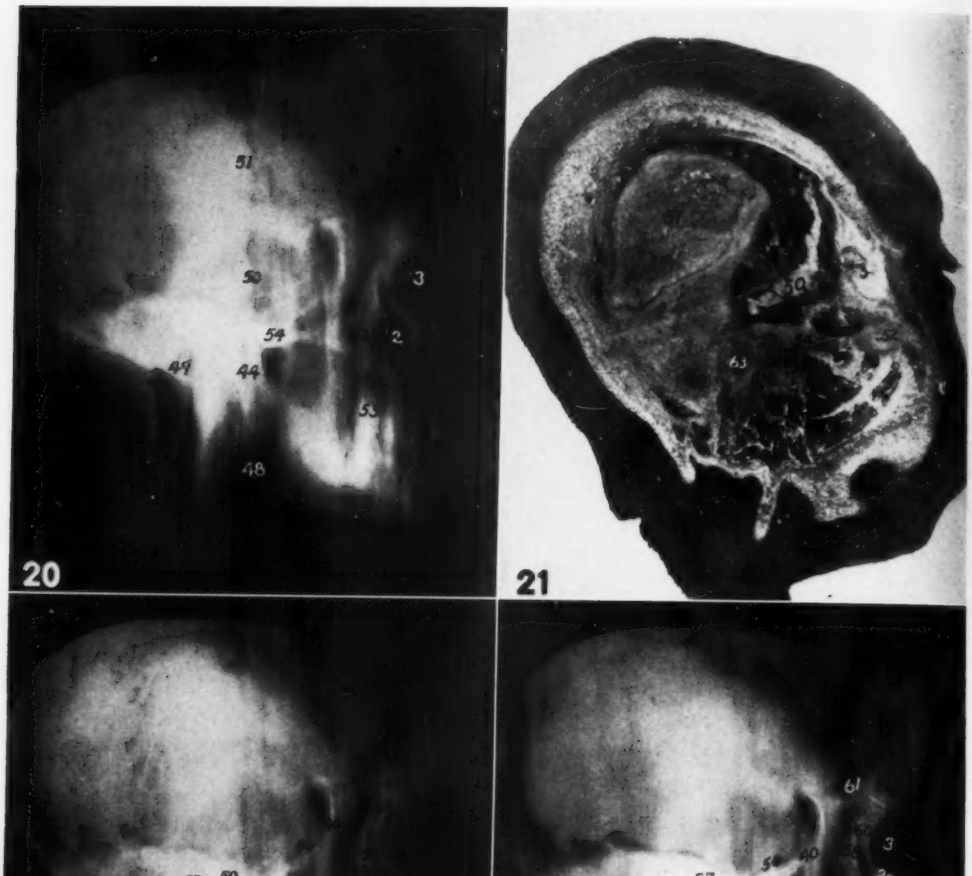


Fig. 20. Sagittal section at the level of the tubercle of the root of the zygomatic process of the temporal bone. 48. Angle of the mandible. 49. Mastoid process. 50. Squamous portion of temporal bone. 51. Parietal bone. 52. Zygoma. 53. Maxilla. 54. Marginal tubercle of zygoma.

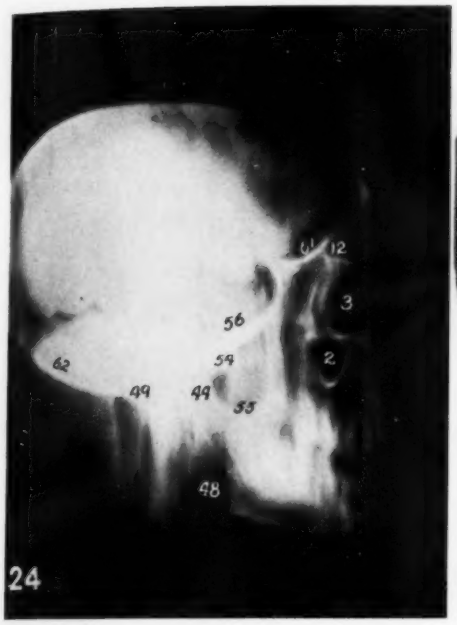
Fig. 21. Anatomic sagittal section at level of tubercle of the root of the zygomatic process of the temporal bone. 3. Orbit. 49. Mastoid process of temporal bone. 50. Squamous portion of temporal bone. 51. Parietal bone. 52. Zygoma. 54. Marginal tubercle of zygoma. 63. Auditory canal.

Fig. 22. Sagittal section at level of tip of mastoid process. 55. Mandibular notch. 56. Floor of middle cranial fossa. 57. Petrous portion of temporal bone. 58. Linear shadow cast by curving surface of zygoma. 59. Zygomatico-frontal suture line.

Fig. 23. Sagittal section at level of the coronoid process of the mandible. 60. Posterolateral orbital wall. 61. Anterior cranial fossa. 62. Posterior cranial fossa.

not in good view. The lateral orbital wall is clearer and larger than in the previous film. The floor of the middle cranial fossa, 56, formed at this level by the greater wing of the sphenoid, 40, and the squamous, 50, and petrous portions, 57, of the temporal bone is just becoming visible.

In Figure 23 we are at the coronoid



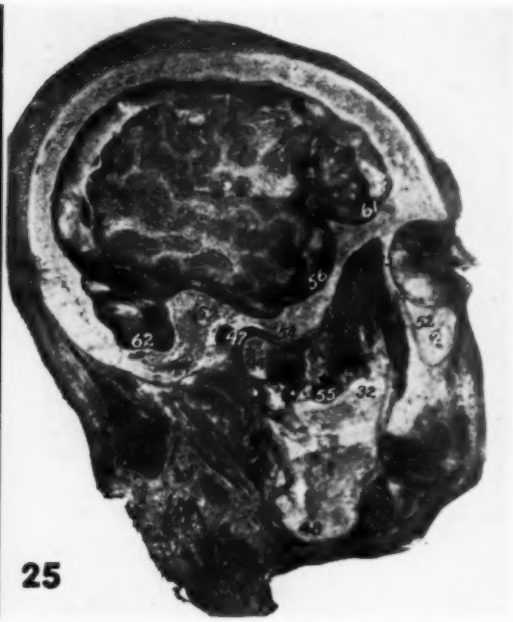


Fig. 24. Sagittal section at level of the condyloid process of the mandible.
Fig. 25. Anatomic sagittal section at the condyloid process of the mandible. 2. Maxillary sinus. 3. Orbital cavity. 14. Frontal process of zygoma. 44. Condyloid process of mandible. 48. Angle of mandible. 49. Mastoid process. 54. Tubercle at the root of the zygomatic process of the temporal bone. 55. Mandibular notch. 56. Middle cranial fossa. 61. Anterior cranial fossa. 62. Posterior cranial fossa.

process, 32, of the mandible. This process, as well as the ascending ramus, 20, of the mandible and its angle, 48, are in sharp detail. The condyle, 44, is in better focus, as are the mandibular notch, 55, and tubercle, 54, of the zygomatic process. We are now within the cavity of the maxillary antrum, 2, and the linear shadow of the curve of the zygoma, 58, is still seen. The posterolateral wall, 60, of the orbit is clear, and the orbital cavity, 3, is larger. The thin inferior wall, 29, of the orbital cavity can be noted separating the orbit, 3, from the antrum. The mastoid process, 49, is still well defined, as are its air cells, although we are beyond its most dependent portion. The middle cranial fossa, 56, is in good focus, the greater wing of the sphenoid, 40, is coming into clearer view, and the petrous portion, 57, of the temporal bone is becoming more prominent. Faintly visible is the anterior cranial fossa, 61, and posteriorly, the posterior cranial fossa, 62, is in good view.

Figures 24 and 25 are comparable tomographic and anatomical levels at the sagittal plane of the condyloid process, 44, of the mandible. This structure is clearly shown in both. The mandibular notch, 55, is clearly outlined. The tubercle, 54, of the root of the zygomatic process of the temporal bone is also seen. The angle, 48, of the mandible is well defined in both views and the shadows of the teeth are making their appearances in the roentgenogram. Slightly above and behind the condyle, 44, of the mandible, the auditory canal is visible. The mastoid process, 49, can be identified in the tomogram, but it is fading from view. We can also see the faint outline of the styloid process, 41, in the tomogram, but it is not apparent in the anatomic section. The maxillary sinus, 2, is clearer on the tomogram than previously. This plane is at a level deeper than the anatomic section, in which only a small portion of the sinus is shown. The frontal process, 14, of the zygoma and a rather indistinct

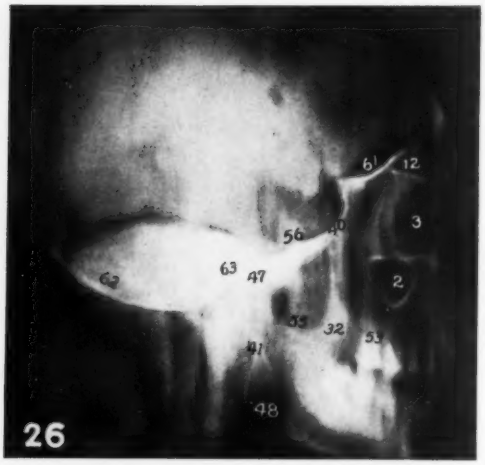
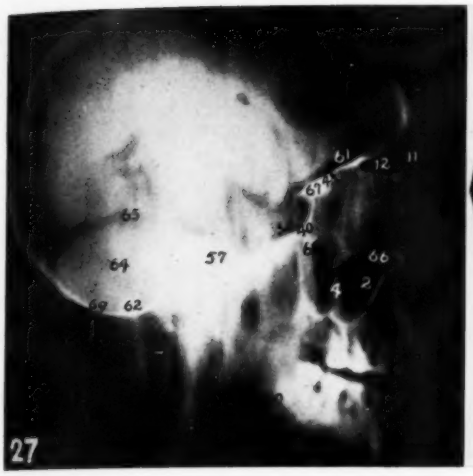


Fig. 26. Sagittal section at the level of the styloid process. 41. Styloid process. 63. Auditory canal.

fusion with the frontal bone are seen. The orbital cavity, 3, is clearly visualized in both views. All the cranial fossae, 61, 56, 62, are recognizable in these views. Between the floor of the anterior cranial fossa, 61, and the superior wall of the orbit there is a wedge-shaped, air-filled cavity. This represents, in this skull, the most lateral projection of the supraorbital sinus, 12. It is more clearly outlined in later films. The anterior walls of this structure are indistinct.

At the next tomographic level, Figure 26, the sagittal plane is at the level of the styloid process, 41. The temporomandibular joint, 47, is still in good focus, and the auditory canal, 63, is well visualized. The presence of an opaque density within its limits suggests that we are at the plane of the ossicles of the middle ear. The coronoid process, 32, is less distinct than in former tomograms. The angle, 48, of the mandible is in good relief, and the shadows of the teeth are becoming clearer. The maxillary antrum, 2, is enlarging, especially posteriorly into the body of the maxilla, 53. The orbital cavity, 3, is fairly well outlined, and the soft-tissue shadows of both eyelids are apparent. All the cranial fossae, 61, 56, 62, are well seen and the greater, 40, and lesser wings, 43, of the sphenoid can be identified. The supraorbital sinus, 12, is in sharper relief and the anterior wall is just visible.

Figures 27 and 28 are tomographic and anatomic views, respectively, at approximately the same level, just lateral to the last lower molar tooth. In both, the posterior portion of the ramus, 20, of the mandible is noted, and the tomogram depicts teeth more clearly than earlier films. The ascending ramus and condyle of the mandible, as well as the temporomandibular joint, are lost to view. The internal auditory canal, 63, and petrous portion, 57, of the temporal bone are demonstrated. In both views, also, cerebellar substance, 64, appears in view and the tentorium cerebelli, 65, is visualized. The anatomic section discloses only a small portion of the maxillary antrum, 2, but the tomogram visualizes this structure in its entirety, extending to the posterior limit of the maxillary bone. The inferior wall of this structure describes a W in its course, the central portion of which is carried upward to the superior wall in a septum, 4, dividing the sinus into two almost equal compartments. The thin orbital plate, 66, of the maxilla can be identified. The osseous limits of the orbital cavity, however, are not distinct, due to the curvature of the walls at this level. The soft-tissue shadows of both eyelids are seen. The supraorbital sinus, 12, is in good detail, and the frontal sinus, 11, just anterior to it is coming into focus. The latter is evident only in the tomogram. All the cranial fossae, 61, 56, 62, are well seen. The overlying edge of the lesser wing of the sphenoid, 43, as it projects to form the anterior clinoid process, 67, is clearly shown. The greater wing of the sphenoid, 40, and petrous portion, 57, of the temporal bone, forming the middle cranial fossa, 56, are discernible. In the tomogram it is possible to identify the spine of the sphenoid bone, 68, projecting downward behind the maxilla below the posterior third of the middle cranial fossa. The posterior cranial fossa, 62, at this level is formed by the concave plate of the occiput, 69, and the petrous portion, 57, of the temporal bone is quite distinct.



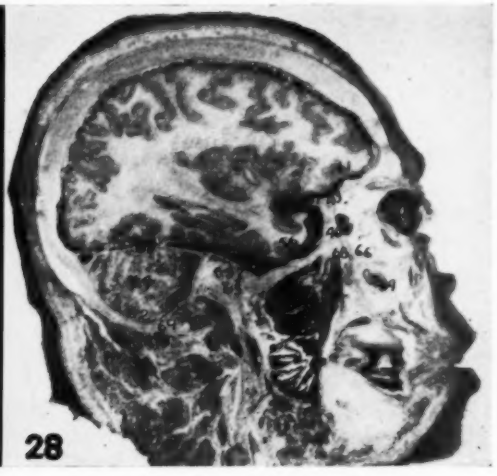


Fig. 27. Sagittal section at a level just lateral to the last molar tooth. 64. Cerebellum. 65. Tentorium cerebelli. 66. Orbital plate of the maxilla. 67. Anterior clinoid process. 68. Spine of the sphenoid bone. 69. Occiput.

Fig. 28. Anatomic sagittal section at a level just lateral to the last molar tooth. 2. Maxillary sinus. 4. Intramaxillary septum. 40. Greater wing of sphenoid bone. 43. Lesser wing of sphenoid bone. 56. Middle cranial fossa. 57. Petrous portion of temporal bone. 61. Anterior cranial fossa. 62. Posterior cranial fossa. 63. Auditory canal. 64. Cerebellum. 65. Tentorium cerebelli. 66. Orbital plate of maxilla. 67. Anterior clinoid process. 68. Spine of sphenoid bone. 69. Occiput (concave plate forming posterior cranial fossa).

In Figure 29 we have entered a tomographic level within the limits of the lower alveolar ridge at the sagittal plane of the second molar tooth. Lower alveolar ridge substance is also fairly well delineated at this level. The upper alveolar ridge is not so distinct. The maxillary sinus, 2, is clear and its osseous limits are in good focus. The orbital cavity, as in the last tomogram, is not well defined. The faint shadows of the posterior ethmoid air cells, 25, are appearing. The supraorbital sinus, 12, is clearer and its posterior extent toward the anterior clinoid process, 67, is visualized. The frontal sinus, 11, is better seen than previously, although not in sharp detail. All the cranial fossae, 61, 56, 62, are well shown. Below the mid-portion of the middle cranial fossa, the faint shadow of the lateral pterygoid plate, 70, can be seen. (Its anterior border is easily confused with the posterior wall of the maxillary antrum, but these two structures are distinct and separate.) The internal auditory canal, 63, is also demonstrated. As in previous tomograms, we are able to distinguish the lateral cerebral ventricle. Just as in the

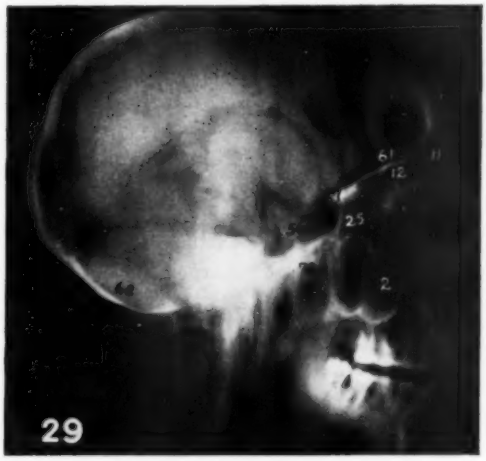


Fig. 29. Sagittal section at the level of the lower second molar tooth. 70. Lateral pterygoid plate.

postero-anterior tomograms, the ventricles are visible in this particular skull. As mentioned previously, this is due to the fact that the skull was exposed to air for some time and the fluid substance has been, for the most part, lost. In ordinary tomography we are not able to distinguish these structures clearly.

Figures 30 and 31 are comparable tomographic and anatomic sections at the sagittal plane of the second lower bicuspid tooth. Bone substance in this area is well seen. The premaxilla, 71, is in fairly good focus, as are the two upper molar and bicuspid teeth. The maxillary antrum, 2, is not quite so clear as in the previous tomogram, but the anatomic section shows this structure exceedingly well. In the tomogram the lateral pterygoid plate, 70, is very well seen, as is also the pterygomaxillary fissure, 72. Its junction with the body of the sphenoid bone, 73, which is beginning to appear in focus, is shown. The sphenoid sinus, 37, is just making its appearance in the tomogram. Above the posterior half of the maxillary antrum in both views we can visualize several posterior, 25, and middle ethmoidal, 8, air cells. Anterior to this area, the orbital cavity, 3, is small and in the tomogram rather indistinct. Supraorbital, 12, and frontal, 11, sinuses are well depicted in the roentgenographic view, while only the former is shown in the anatomic section. The anterior clinoid process, 67, is still visualized, and all the cranial fossae, 61, 56, 62, are well seen. The channel of the internal auditory canal, 63, is visualized in the anatomic view. Although radiographic visualization of the cervical spine is evident, these anatomic relations are not pertinent to the subject under discussion, and identification of these structures is therefore omitted.

Figures 32 and 33 are approximately corresponding tomographic and anatomic levels at the sagittal plane of the level of the first lower bicuspid tooth. The anterior portion of the mandibular ramus, is well seen in both views. The maxillary antrum, 2, at this level is much smaller and elongated anteroposteriorly in the anatomic view. In the tomogram, because of the inclusion of a certain amount of tissue in the focal field, we are able to delineate the entire width and length of the sinus, but as in the last tomogram, it is not so clear as previously and is receding from the tomographic field. The pterygomaxillary fissure, 72, is well outlined in the tomogram and is also visible in the anatomic view, the medial plate of the pterygoid process, 74, also being delineated. The horizontal plate of the palatine bone, 75, is also in view, and in the tomogram the indistinct shadow of the soft palate, 76, is making its appearance. The premaxilla, 71, is seen in both sagittal views. The orbital cavity at this level is very small and is not well outlined. In the tomogram, the body of the sphenoid bone, 73, is shown and the sphenoid sinus, 37, is visualized. Because we are lateral to the mid-line of the skull, the sinus appears to encroach upon the sella turcica, 77, which is making its appearance, but this is due to superimposition of images. In the anatomic view, only a small portion of the sphenoid air cell is visible, and the sella is not so well formed. In both views posterior, 25, middle, 8, and a few anterior ethmoid air cells are delineated. The supraorbital sinus, 12, is smaller in both views and the frontal sinus, 11, is quite well demonstrated. In the anatomic view we are beyond the petrous portion of the temporal bone and note the junction of the basiocciput, 81, and the sphenoid bone. Receding from distinct view, but still apparent in the tomogram, is the petrous portion of the temporal bone, 57, as well as the internal auditory canal, 63. The dorsum sellae, 78, is fairly outlined. The rather thin inferior wall of the occiput, 69, is quite well seen in both views. Tongue, 28, substance is evident.

At the next tomographic and anatomic level, shown in Figures 34 and 35, we are at the sagittal level of the lower lateral incisor teeth. The premaxilla, 71, and palatine process of the maxillary bone, 79, are quite clear, and the horizontal plate of the palatine bone, 75, is also distinct. A portion of the perpendicular plate, 80, of the latter is seen in the anatomic section, while the tomogram shows this portion of the palatine bone rather indistinctly. The maxillary sinus has disappeared from view, and in the tomogram we begin to observe the forms of both inferior, 7, and middle

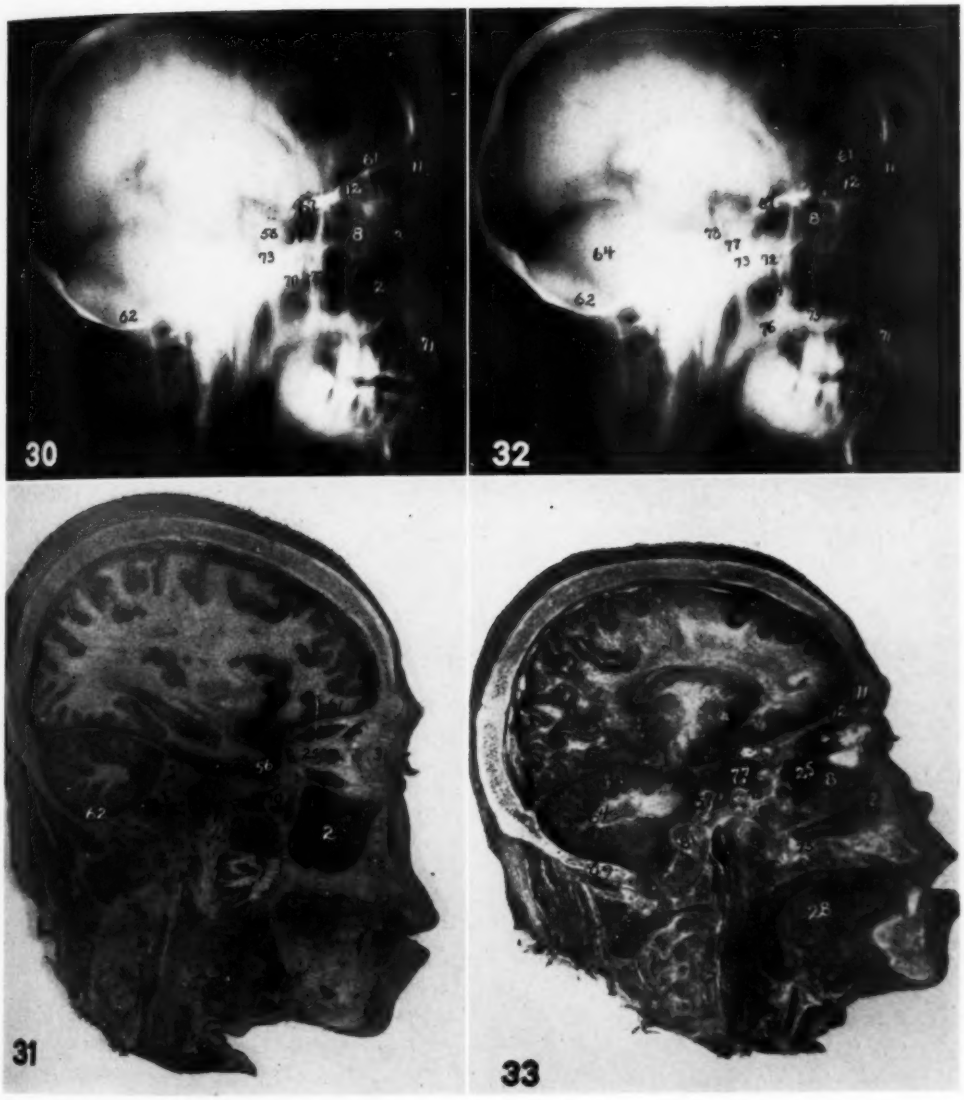


Fig. 30. Sagittal section at the level of the second lower bicuspid tooth. 71. Premaxilla. 72. Pterygo-maxillary fissure. 73. Body of sphenoid bone.

Fig. 31. Anatomic sagittal section at the level of the second lower bicuspid tooth. 2. Maxillary sinus. 3. Orbital cavity. 12. Supraorbital sinus. 56. Middle cranial fossa. 61. Anterior cranial fossa. 62. Posterior cranial fossa. 63. Auditory canal. 67. Anterior clinoid process. 71. Premaxilla. 73. Body of sphenoid bone.

Fig. 32. Sagittal section at the level of the first lower bicuspid tooth. 74. Medial pterygoid plate. 75. Horizontal plate of palatine bone. 76. Soft palate. 77. Sella turcica. 78. Dorsum sellae.

Fig. 33. Anatomic sagittal section at level of the first lower bicuspid tooth. 2. Maxillary sinus. 8. Middle ethmoidal air cells. 11. Frontal sinus. 12. Supraorbital sinus. 25. Posterior ethmoidal air cells. 28. Tongue. 57. Petrous portion of temporal bone. 64. Cerebellum. 69. Occiput. 71. Premaxilla. 72. Pterygo-maxillary fissure. 73. Body of sphenoid bone. 74. Medial pterygoid plate. 75. Horizontal plate of palatine bone. 76. Soft palate. 77. Sella turcica.

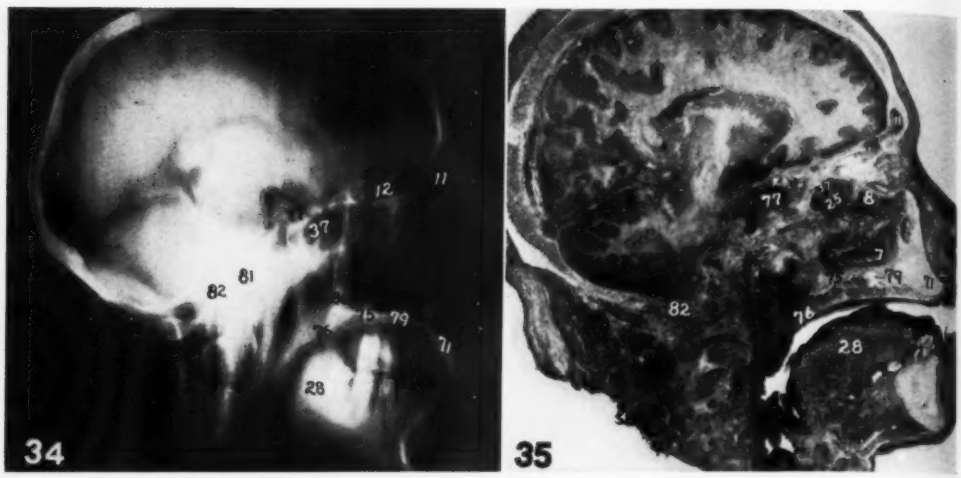


Fig. 34. Sagittal section at level of lower lateral incisor teeth. 79. Palatine process of maxillary bone. 80. Perpendicular plate of palatine bone. 81. Basi-occiput. 82. Foramen magnum.

Fig. 35. Anatomic sagittal section at level of lower lateral incisor teeth. 7. Inferior concha. 8. Anterior and middle ethmoidal air cells. 11. Frontal sinus. 12. Supraorbital sinus. 16. Middle concha. 25. Posterior ethmoidal air cells. 28. Tongue. 37. Sphenoid sinus. 71. Premaxilla. 75. Horizontal plate of palatine bone. 76. Soft palate. 77. Sella turcica. 79. Palatine process of maxillary bone. 80. Perpendicular plate of palatine bone. 82. Foramen magnum.

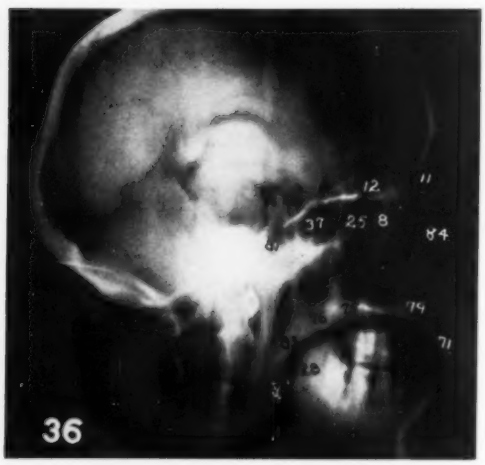


Fig. 36. Sagittal section at the level of the lower central incisor teeth. 83. Uvula. 84. Nasal bone.

conchae, 16. In the anatomic view we are just able to distinguish a portion of the inferior concha, 7, within the nasal chamber. The orbital cavity has almost completely disappeared and we can visualize anterior, middle, 8, and posterior ethmoid sinuses, 25. The sphenoid sinus, 37, is now clear in both views, although superimposition upon the sella turcica, 77, still exists in the tomogram. The supraorbital sinus, 12, is still in view and the frontal sinus, 11, is very clear. In the tomogram what appears to be the ostium of the frontal sinus is seen. The hypophyseal fossa is still not clearly outlined in the anatomic section, but is quite clear in the tomograph. We are beyond the petrous portion of temporal bone in both views, and the basi-occiput, 81, and beginning of the foramen magnum, 82, are shown. The soft-tissue shadows of both the soft palate, 76, and tongue, 28, are clearer than in previous views.

Figure 36 is the tomographic view of the sagittal plane at the level of the lower central incisor. The anterior portion of the mandible is quite clear. The premaxilla, 71, and palatine process of the maxillary bone, 79, are clear, and both horizontal, 75, and perpendicular, 80, plates of the palatine are well seen. The soft-tissue shadows of the soft palate, 76, and tongue, 28, are more pronounced and the uvula, 83, is becoming distinct. The outlines of both middle, 16, and inferior, 7, conchae are still visualized but not so clearly as in the last tomographic view. The body of the sphenoid bone, is quite clear, and the sphenoid

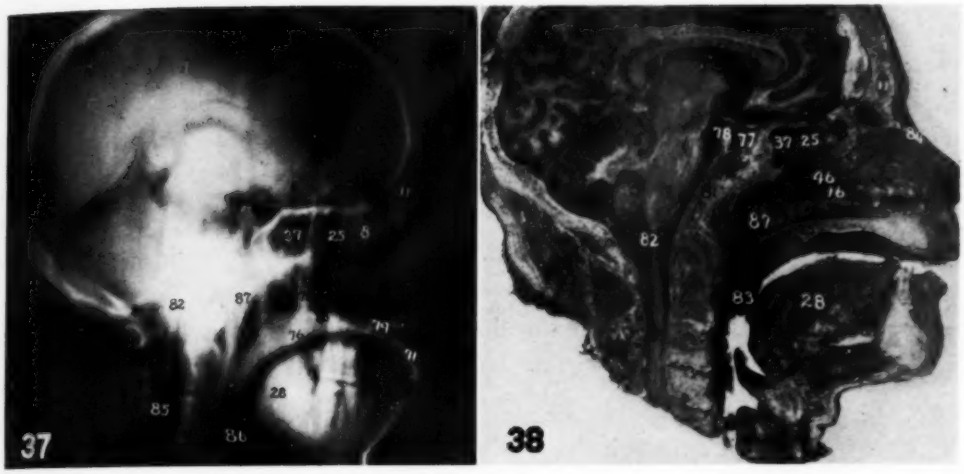


Fig. 37. Sagittal section at level of the mid-line of the skull. 85. Spinal cord. 86. Laryngeal part of pharynx (hypopharynx). 87. Nasopharynx.

Fig. 38. Anatomic sagittal section at the mid-line of the skull. 8. Anterior and middle ethmoidal air cells. 11. Frontal sinus. 25. Posterior ethmoidal air cells. 28. Tongue. 37. Sphenoid sinus. 71. Premaxilla. 75. Horizontal plate of palatine bone. 76. Soft palate. 77. Sella turcica. 78. Dorsum sellae. 79. Palatine process of maxillary bone. 81. Basi-occiput. 82. Foramen magnum. 83. Uvula. 84. Nasal bone. 85. Spinal cord. 86. Laryngeal part of pharynx (hypopharynx). 87. Nasopharynx.

sinus, 37, is excellently outlined. All ethmoidal sinuses from anterior to posterior, 25, are seen, as is the supraorbital air cell, 12. The frontal sinus, 11, is in very clear detail and the nasal bone, 84, is beginning to be seen. The hypophyseal fossa, 77, is in good focus. The foramen magnum, 82, appears larger than in the last roentgenogram.

Our last views, Figures 37 and 38, are at the sagittal plane of the mid-line of the skull and represent the tomographic and anatomic views in that plane. The mandible in this area is delineated in both views, as are the central incisors. Tongue substance, 28, soft palate, 76, and uvula, 83, are also well seen in both. The premaxilla, 71, palatine process of the maxilla, 79, and the horizontal plate of the palatine bone, 75, are in good view. A portion of the perpendicular plate, 80, is shown in the tomogram. The maxillary sinus and orbital cavity are out of the focal field. Anterior, middle, 8, and posterior, 25, ethmoid sinuses are visualized, and the frontal sinus, 11, is seen in excellent detail, especially in the roentgenogram. The supraorbital sinus is not visualized in either view. The sphenoid sinus, 37, is very well seen, and the hypophyseal fossa, 77, is clear in both views. The dorsum sellae, 78, can be outlined. The basi-occiput, 81, and foramen magnum, 82, are well depicted, and it is possible to distinguish the spinal cord, 85, as it enters the cranial vault in both these views. In both the anatomic section and the tomogram we can follow the posterior pharyngeal walls from the laryngeal part of the pharynx, 86, up to the roof of the nasopharynx, 87, and it is possible to visualize the inferior, 7, middle, 16, and superior, 46, conchae. The orifice of the eustachian tube is visible in the anatomic section, lying just above the posterior portion of the horizontal plate of the palatine bone.

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Osteitis Deformans: Paget's Disease of the Bone[1]

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OSTEITIS deformans was described by Sir James Paget (1) in 1876 and now bears his name. Very little has been added to his explicit observations on the advanced clinical form of the disease. Biochemical, pathologic, and roentgenologic investigations have made it possible, however, to segregate osteitis deformans in its preclinical stage from a large group of forms of benign osteitis.

At the Mayo Clinic prior to January 1938, a diagnosis of osteitis deformans was made in 367 cases. The analysis of the findings in that group will be given in this paper. It is not a new observation that osteitis deformans manifests itself roentgenologically in various forms. In this study, however, we shall attempt to correlate the clinical manifestations of the disease with the roentgenologic evidence in a series of 200 cases. The criteria for the roentgenographic classification will be discussed later.

HISTORICAL REVIEW

Both Wrany, in 1867, and Wilks (2), in 1869, as quoted by Paget, deserve credit for recognizing the clinical form of osteitis deformans. The two cases described by those men were among the five recorded in Paget's original paper. Paget was inclined to believe that the disease was of recent origin, but paleopathologic evidence based on old museum specimens is an indication of its presence long before modern times. Denninger (3) described gross morphologic and roentgenologic evidence of osteitis deformans in the skeletons of five American Indians, excavated from the Illinois River valley. Fisher (4) reported additional paleopathologic evidence of the condition in two tibiae; the disease is well described and well illustrated in his paper. Following the examination of a number of skulls in the South Kensington Natural History Museum, Butlin (5) expressed the opinion that the Neanderthal skull had the appearance of a specimen representing osteitis deformans.

ETIOLOGY

As the term osteitis deformans implies, Paget (1) believed the disease to be a chronic inflammatory process. Fairly frequently, local heat may be demonstrated in the involved bones, particularly in those which are easily palpable, as for example the tibia and even occasionally the ilium.

DaCosta *et al.* (6) referred to the work of Morpure, Archangeli and Fiocca, who claimed to have found a diplococcus in the bones of patients suffering from osteitis deformans and osteomalacia. DaCosta and his associates unsuccessfully attempted to prepare a vaccine, but cultures and animal inoculation gave negative results. Knaggs (7 and 8) expressed the belief that a toxin was responsible for osteitis deformans. In his opinion the proliferative changes were more prominent than the

[1] Abridgment of thesis submitted by Dr. Dickson to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M.S. in Orthopedic Surgery. Accepted for publication in September 1944.

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TABLE I: STUDIES OF THE BLOOD IN 367 CASES OF OSTEITIS DEFORMANS*

	Patients	Determinations	Concentration		
			Minimum	Maximum	Average
Calcium	117	167	8†	11.6†	9.8†
Phosphorus	111	163	1.6†	5.3†	3.48†
Alkaline phosphatase	101	148	1.3‡	216‡	25.53‡

* The chemical work was performed by the Section on Clinical Biochemistry under the direction of Dr. Osterberg.
† Mg. in each 100 c.c. of serum.
‡ Bodansky units in each 100 c.c. of serum.

vascular disturbances, and evidence of leukocytic migration was minimal. Such changes, when not to be explained on a bacterial basis, may be the result of repeated slight mechanical injuries, or more often the effects of perverted metabolism and continued slight intoxication, affecting particularly certain tissues. According to Knaggs, changes of the medullary tissue of patients whose condition has been diagnosed as osteitis deformans conform to this description and are attributable to irritation by a toxin.

Lancereaux (9), in 1883, suggested that the central nervous system played an important role in the production of osteitis deformans. This hypothesis has gained consideration from time to time, mainly on the ground of the frequent occurrence of skeletal changes, neurotrophic in origin, among patients whose condition has been diagnosed as tabes dorsalis or syringomyelia.

In 1884, Gilles de la Tourette and Marenesco (10) found lesions in the medulla and peripheral nerves associated with osteitis deformans but thought that they were the result of senility. Such associated lesions of the central nervous system are so diverse that it is much more reasonable to regard them as mechanical in origin or the result of arteriosclerosis than as causative factors in the production of osteitis deformans.

Lannelongue (11) and Fournier (12), as well as many other French investigators, have urged the syphilitic origin of osteitis deformans. Kay and her associates (13), in a study of 34 cases with a diagnosis of osteitis deformans, found the Wassermann reaction positive in 3. Gutman and Kasabach (14) reported a positive Wassermann reaction in 7 of a series of 116 cases. Among our 367 cases, there were only 11 in which a positive Wassermann reaction was obtained. From these observations there is little to suggest syphilis as a causative factor.

DaCosta and his associates considered osteitis deformans a disorder of metabolism of bone dependent on the absence or perversion of some internal secretion. Since the suggestion of this possibility, numerous hypotheses of a similar nature have been put forth. Albright, Aub and Bauer (15), however, held that osteitis deformans is not a form of hyperparathyroidism, as some authors have contended: first, because, though osteitis deformans is often polyostotic, it is never generalized, which is almost inconceivable for a metabolic disease; second, because of failure to demonstrate histologic changes in the parathyroid glands of patients suffering from osteitis deformans; and, third, on account of the lack of similarity of the metabolic changes of the two conditions.

The range of the serum calcium of the blood observed in our cases (Table I) does not give any indication of disturbed calcium metabolism. Furthermore, in osteitis deformans different phases of a similar pathologic process are observed in the same bone. If the parathyroid gland or other glands of internal secretion were at fault, it would be difficult to explain such variability. Instead, one would expect to find a more uniform, generalized process, as demonstrated in the bones in cases of hyperparathyroidism.

Moehlig (16 and 17), having obtained a family history of diabetes mellitus in 5 of 12 patients with osteitis deformans, stresses the former disease from an etiologic stand-

point. In the present study only 6 of the patients had diabetes mellitus as a complicating factor and only 18 gave a family history of diabetes.

AGE INCIDENCE

Osteitis deformans usually manifests itself during middle life; it is encountered rarely before the age of thirty years. In one of the cases included in Paget's series the onset occurred at twenty-eight years. One of the patients in our series was a man of twenty-nine at the time the diagnosis was made. Roentgenologic changes typical of this condition were observed in the lumbar segment of the spinal column, sacrum, pelvis, and femora. Osteoporosis circumscripta was observed in the skull. This patient gave a history of pain in the right hip and low back region of four years' duration. Packard, Steele, and Kirkbride (18) found the average age at onset to be forty-nine and a half years in a series of 51 cases; the youngest patient was thirty-nine and the oldest eighty-two years of age. In a series of 34 cases, Kay and her associates (13) found the average age, on examination, to be fifty-five years, the youngest patient being thirty-nine and the oldest seventy-eight. The average age at onset of symptoms was forty-six years; the youngest patient was thirty and the oldest sixty years old.

In our series of 367 cases, the average age at the time diagnosis was made was fifty-six years, while the average age at onset of symptoms was fifty-three. The youngest patient was twenty-nine years of age (Table II) at diagnosis, and the oldest was eighty-three.

SEX INCIDENCE

In 1901, Packard, Steele, and Kirkbride (18), in a review of the literature, found osteitis deformans reported as affecting forty-one men and twenty-four women. In Roberts and Cohen's series (19) there were 11 men and 5 women. In a series reported by Gutman and Kasabach (14) there were 58 men and 58 women. Our group consisted of 246 men and 121 women.

TABLE II: OSTEITIS DEFORMANS: AGE AT ONSET AND AGE AT DIAGNOSIS

Age at Onset		Age at Diagnosis	
Years	Cases	Years	Cases
18	1	...	...
20–29	10	29	1
30–39	44	30–39	29
40–49	73	40–49	70
50–59	128	50–59	134
60–69	84	60–69	97
70–79	25	70–79	33
80–89	2	80–89	3
Total	367		367

FAMILIAL INCIDENCE

The occurrence of osteitis deformans in more than one member of a family has been recorded fairly frequently. Roberts and Cohen (19) in their review of the literature found 13 cases in which there was a familial background. Two of these cases were their own; in these the patients were sisters. In our group 16 patients had 21 relatives for whom a similar diagnosis had been made. In 2 cases there was a family history of the condition affecting more than one relative. In one of these cases the patient's mother, brother (a physician), maternal grandmother, maternal great grandmother, and one aunt were affected with the same disease. In another case, the patient's sister and one brother had osteitis deformans. In one instance a diagnosis of osteitis deformans involving the tibia was made in each of identical twins.

MODE OF ONSET

Osteitis deformans may be present for many years without the patient's cognizance of anything unusual. It is a common occurrence for the condition to be discovered incidentally in the course of roentgenologic examination of the genitourinary tract, thorax, paranasal sinuses, or gastro-intestinal tract. Gutman and Kasabach's analysis (14) of data on 116 cases revealed the fact that in 27 the patients had not observed any symptoms and there was no indication of the existence of the condition at the time the roentgen diagnosis was made. In our series of 367 cases, 75 patients (20 per cent) had no complaints

and were not aware of anything unusual which could be attributed to the osteitis deformans (Table III).

TABLE III: OSTEITIS DEFORMANS: MAJOR COMPLAINTS IN 367 CASES*

Complaint	Patients
Backache	119
Headache	64
Pain in legs	58
Pain in hips	55
Deafness	53
Fatigue	49
Pain in knees	46
Vertigo	37
Pain in thighs	29
Tinnitus	24
Neuralgia	17
Sciatica	11
Loss of sense of taste	2
Loss of sense of smell	2
No complaint	75

* More than one complaint in a number of cases.

ROENTGENOLOGIC MANIFESTATIONS

Many investigators have observed the variation of the roentgenologic manifestations of osteitis deformans. Various bones display discernible features dependent on the phase of the disease and upon their own architecture. On the basis of this variation, an attempt has been made to classify the disease into two phases: (1) the sclerotic phase (Fig. 1) and (2) the combined phase (Fig. 2).

For this study we have selected the roentgenograms of 200 of our 367 patients, 100 cases representing each phase. A study has been made correlating the clinical aspect with the roentgenographic manifestation of the disease as it is encountered in the pelvis and long bones. In some cases both phases occurred in the same patient; the type in these instances has been determined by the predominant roentgenologic manifestation. The criteria for this classification of the changes encountered in the pelvis and long bones will be discussed individually.

Pelvis: In our group of 367 cases the pelvis was the most frequent site of osteitis deformans (Table IV). Schmorl's analysis (20), from an anatomic standpoint, of a great number of cases revealed the disease most frequently in the spinal column, including the sacrum.

In the pelvis, the sclerotic phase is characterized roentgenographically by a homogeneous increase of density of bone, with detail of the cancellous trabeculae no longer perceptible. This form of the disease may involve one or both sides of the pelvis, or it may be confined to any portion of the innominate bones. The ilium is the most frequent site of this sclerotic phase.

TABLE IV: LOCATION OF OSTEITIS DEFORMANS IN 367 CASES*

Site of Involvement	Cases†	Combined Phase‡ (100 Cases)	Sclerotic Phase‡ (100 Cases)
Pelvis	243		
Iliac bones	...	107	100
Ischii	...	97	73
Pubic bones	...	96	73
Femur	171	68	40
Skull	153	...	...
Tibia	127	51	22
Sacrum	...	42	35
Lumbar spine	103	38	30
Dorsal spine	51	16	9
Clavicle	33	8	15
Humerus	20	9	1
Ribs	12	2	...
Scapula	7	1	...
Radius	7	1	...
Cervical spine	6	2	...
Fibula	6	2	...
Ulna	5	1	...
Os calcis	4	1	2
Patella	4	2	...
Talus	1	...	1

* Not including bones of the face and base of skull. More than one site of involvement in a number of cases.

† Cases of involvement of given site among total 367 cases.

‡ Classified roentgenographically. In these columns bilateral involvement is counted twice.

The second form of the disease observed in the pelvis has a more complex roentgenographic picture. It has been termed the combined phase, as it represents nonhomogeneous alterations of density of bone. Roentgenographically, areas of osteoporosis, osteosclerosis, and cysts are demonstrable. In the osteoporotic regions the cancellous trabeculae may be much coarser than normal and distorted in contour. The sclerotic areas are very similar to those already described; they are confined mainly, however, to the brim and that portion of the pelvis subjected to stress. From an anatomical standpoint,

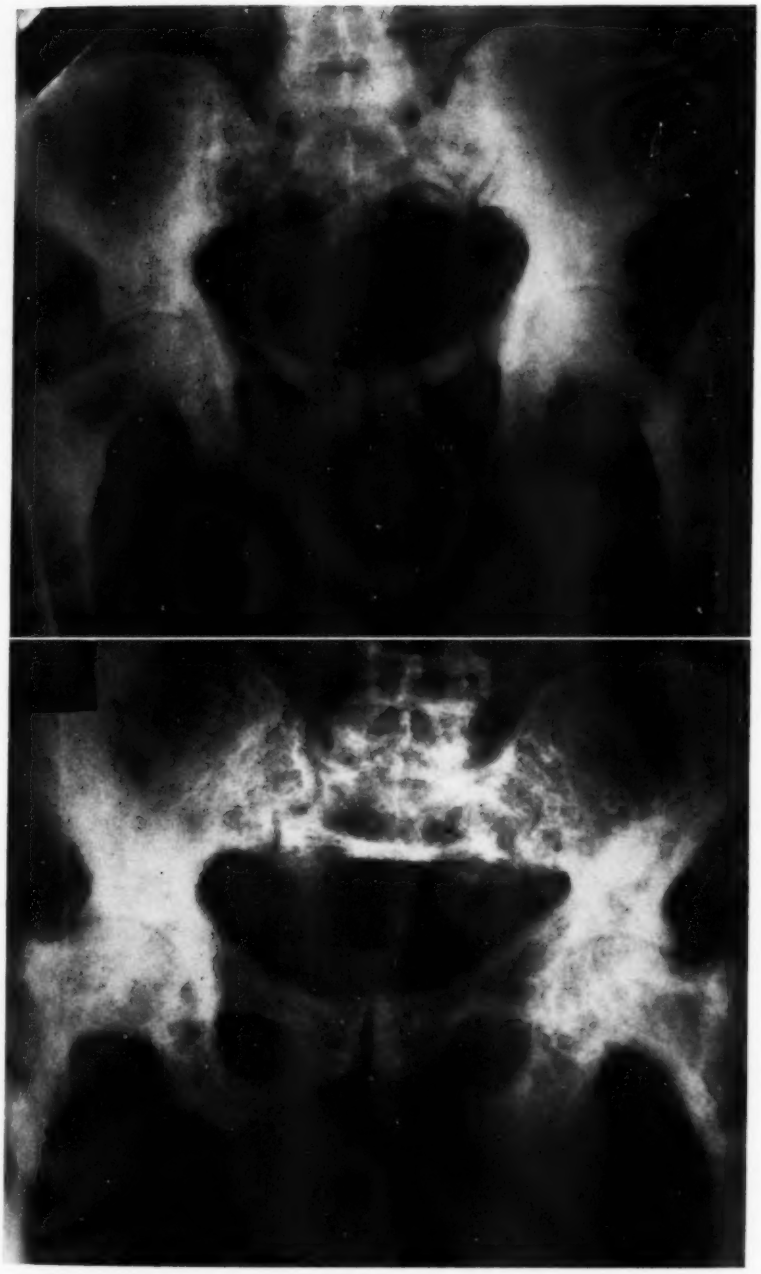


Fig. 1 (above). Homogeneous increase of density of bone with loss of detail of the cancellous trabeculae, which represents the sclerotic phase of osteitis deformans.
Fig. 2 (below). Areas of osteoporosis, osteosclerosis, and cysts, which represent the combined phase of osteitis deformans.

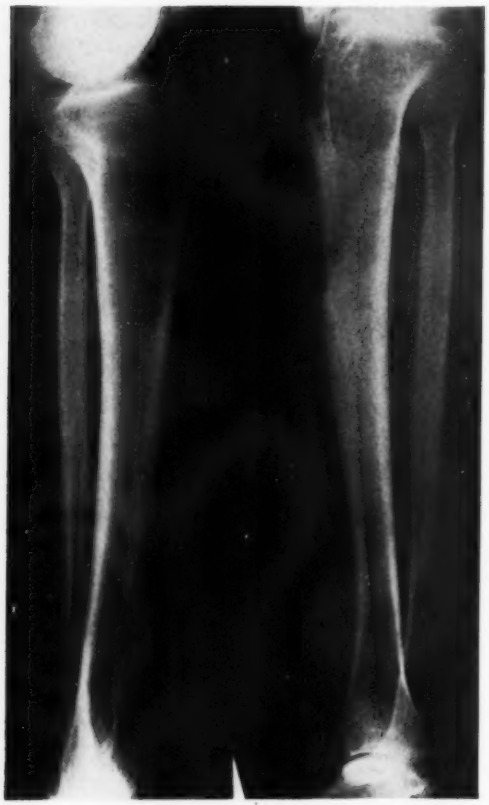


Fig. 3. Zones of osteoporosis (halisteresis) in the upper and lower ends of both tibiae. These zones represent an early phase of osteitis deformans.

the cyst-like lesions encountered in the roentgenogram represent marrow spaces filled with fat and surrounded by dense trabeculae. They will be discussed more thoroughly later in the course of this paper (page 460).

Sutherland (21) has emphasized the increase of dimensions of the pelvic bones of patients with osteitis deformans as an important point in its differentiation from metastatic cancer, particularly metastases originating from the prostate gland. Osteoplastic carcinomatous metastasis does not produce the deformity of the pelvis often seen in osteitis deformans. Brailsford (22 and 23) has pointed out isolated areas of destruction of the peripheral bony outline in cases of metastasis and has recognized that in such cases the increased density results, not from coarsened and fused trabeculae, but from deposition of calcium within the cancellous mesh.

Femur: The second most common site of osteitis deformans in our series of cases, was the femur (Table IV). The high incidence here may be partially accounted for by the frequency with which the upper ends of the femurs were observed in the roentgenograms of the pelvis. The two forms of the disease already described as occurring in the pelvis are observed also in the femur. However, certain variations from the appearance in the pelvis are encountered because of the shape of the long tubular bones. The characteristic deformities observed in the femur are coxa vara and anterolateral bowing of the shaft.

Tibia: As has been stated, there are two forms of osteitis deformans involving the tibia. The earliest roentgenographic evidence of the disease is acute halisteresis, which is most readily demonstrable here. An example is shown in Figure 3. Extension of the disease process, particularly in the tibia, is sharply demarcated from normal bone by a V-shaped region of osteoporosis. The diseased portion of bone has a greater circumference than the adjacent uninvolved portions.

Brailsford (23) expressed the opinion, from a roentgenologic standpoint, that the disease may spread by one of two ways, *via* the periosteum or the endosteum. When the spread occurred by the latter route, the changes were found to be slower than when it occurred by way of the periosteum, and the margins were diffuse. On the other hand, when the spread occurred *via* the periosteum, the latter was gradually elevated from the surface of the bone as a result of a massive growth of subperiosteal osteoid tissue. The tibia occasionally becomes much hypertrophied and a considerable degree of anterior bowing may occur.

Spinal Column: An alteration in the density of bone of some anatomic unit of the vertebral column is the earliest demonstrable roentgenographic manifestation of osteitis deformans of the spine; it

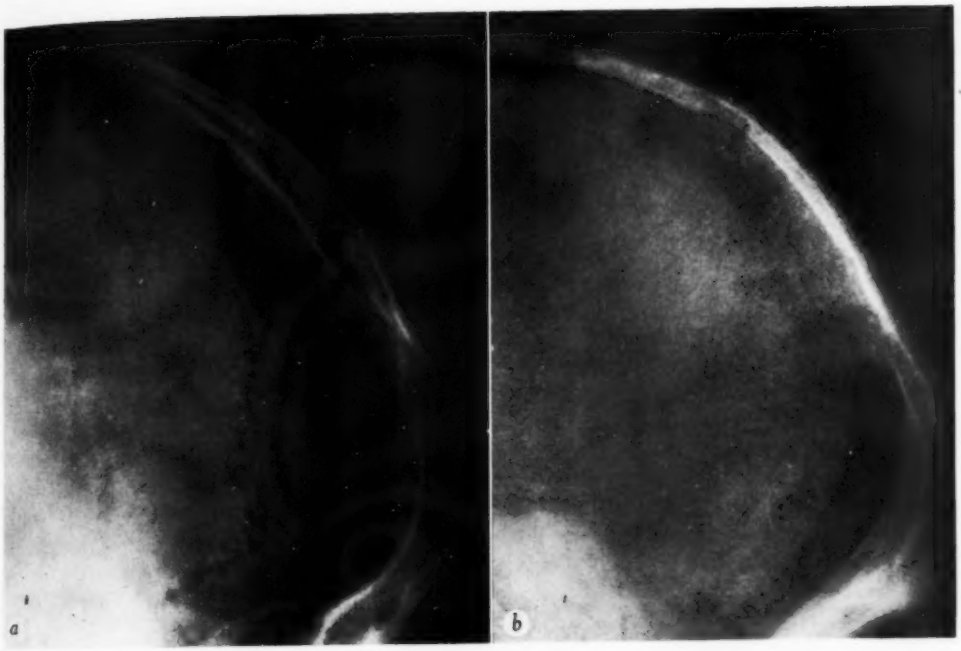


Fig. 4. Lateral views of the parieto-occipital region. *a*. Normal skull. *b*. Diffuse mottled osteoporosis, an early manifestation of osteitis deformans.

occurs most frequently in the body of the vertebra. The most obvious roentgenographic sign of involvement is an increase of the density of the bone as a result of thickening of the trabeculae. These changes occasionally simulate those seen in hemangioma of the vertebra. An increase of the dimensions of the body of the vertebra is frequently encountered.

Skull: Osteitis deformans in the skull is usually associated with characteristic changes elsewhere in the skeleton. Recognition of the various early roentgenographic manifestations of the disease in the skull is difficult, particularly when changes are not demonstrable in other bones. It is the opinion of one of us (Camp) that localized or diffuse areas of finely mottled osteoporosis of the skull are an early roentgenographic sign of the disease (Fig. 4). This mottled region of osteoporosis may be associated with zones of diffuse osteoporosis or minute opacities, varying in size from 2 mm. to 1 cm. or more in diameter. In some instances mottled osteoporosis may be the only roentgen evidence of the disease in the skull.

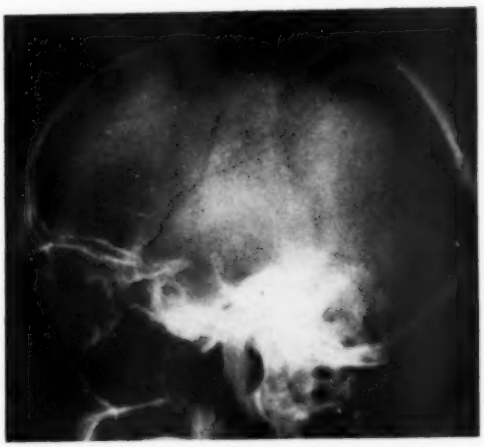


Fig. 5. Lateral view of skull; circumscribed region of osteoporosis in the posterior portion.

Kasabach and Gutman (24), following a study of their own cases and a review of the literature, concluded that osteoporosis circumscripta of the skull, although a

related process, is relatively independent of osteitis deformans (Fig. 5). In our study of the roentgenograms of 117 patients whose skulls were involved by osteitis deformans, we found 26 cases in which osteoporosis circumscripta was present. In 21 of these cases the osteoporosis was associated with osteitis deformans elsewhere in the skeleton. In some instances subsequent roentgenographic examination demonstrated multiple shadows of increased density of bone, typical of osteitis deformans, appearing in the sharply defined areas of osteoporosis (Fig. 6).

The later roentgenographic changes in the skull consist in multiple shadows of increased density with woolly margins, scattered throughout a thickened calvarium. Usually these changes are associated with areas of diminished density, particularly in the temporal and occipital regions. The outlines of the diploe, vascular markings, and suture lines ultimately become obliterated. The contour of the inner table remains distinct, while identification of that of the external table becomes difficult. Exaggeration of these processes may continue until, in some instances, the thickness of the skull is 1 1/2 inches (4 cm.) or more. Under such circumstances, softening of the base of the skull may result in basioccipital protrusion into the cranium. This condition was observed in 6 of our cases (Table V).

TABLE V: INCIDENCE OF PATHOLOGIC FRACTURE IN 367 CASES OF OSTEITIS DEFORMANS

Location of Fracture	Patients
Thoracic portion of spinal column	24
Lumbar portion of spinal column	24
Right femur	8
Left femur	1
Right tibia	6
Left tibia	3
Right humerus	1
Left humerus	1
Separation of tibial tubercle	2
Ischium (only ununited fracture observed)	1
Basioccipital protrusion (extensive)	6
Total number pathologic fractures among 62 patients	77

Our study does not include cases in which osteitis deformans has been encountered in the bones of the face. In an interesting and enlightening study by Stafne and Austin (25), it was found that dental roentgenograms revealed early evidence of the disease. It was present in the maxilla or mandible in 23 cases of a series of 138 in which osteitis deformans had involved one or more bones of the skeleton. The maxilla was involved in 20 of these 23 cases and the mandible in 3. A detailed report of one case was given, in which it was felt possible that the disease was primarily evident in the maxilla.

Upper Extremity: Osteitis deformans occurs much less frequently in the upper extremity than in the lower extremity (Table IV). The roentgenographic appearance is similar to that in the other long bones.

Thorax: Demonstration of osteitis deformans in the clavicle is fairly common, and in some instances is possible during the early stage of the disease, while involvement of the ribs, sternum, and scapula does not occur, as a rule, until the process has become widespread.

Bones of the Foot: In our series we found involvement of the bones of the foot in 5 instances (Table IV). The examination of the diseased bones revealed dense, coarse trabeculae, of considerably increased dimensions.

SYMPTOMS

Twenty-seven of Gutman and Kasabach's 116 patients (14) were asymptomatic at the time the diagnosis of osteitis deformans was made. Seventy-five (20 per cent) of the patients in our series were unaware of any unusual condition so far as the osteitis deformans was concerned (Table III). We examined the roentgenograms of 48 of these 75 patients and classified them, as we have described previously. In 29 the lesions were found to be of the sclerotic type, while 19 were of the combined type.

There is great variation in the pain of osteitis deformans. It is described most frequently as "rheumatic-like." Backache and pain in the lower extremity are encountered frequently (Table III). The pain may be shooting, knife-like, or dull

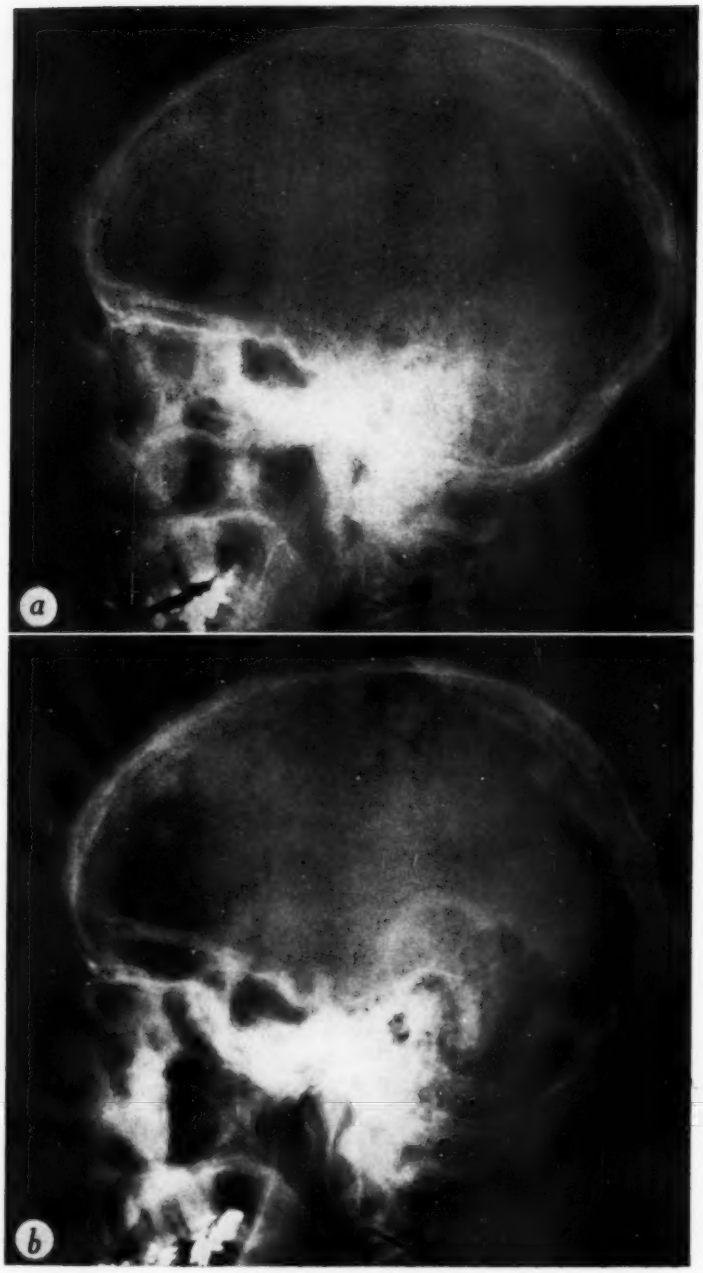


Fig. 6. Lateral views of skull showing osteoporosis. *a*. Extension and sharply defined regions of osteoporosis with thickening and opacities, particularly in the frontal region (osteoporosis circumscripta). *b*. View of same skull taken four and two-thirds years later, showing extension of the osteoporotic zone and typical osteitis deformans.

and aching. There are varying degrees of stiffness of joints, but in some instances the stiffness can be explained on an osteoarthritic basis. In some cases there is a cramp-like pain in the calf muscles. This probably results from ischemia, on an arteriosclerotic basis. Excruciating neuralgic pain of the head and face (Table III) caused considerable distress. Headache, a common complaint, occurred in all portions of the skull and varied considerably in character. In some of the cases, it could be explained on the basis of associated arteriosclerosis and hypertension.

Deafness was given consideration only in those cases in which there was involvement of the skull. Following a study of their cases and a review of the literature, Lindsay and Perlman (26) concluded that impairment of the inner ear is a characteristic finding in those cases of osteitis deformans in which deafness is a complicating factor.

Fatigue was a major feature in 49 of the cases in our series, and in some instances physical exhaustion could be brought on with only minimal exertion. Fatigue was particularly common in those cases in which there was extensive deformity.

LESIONS OF THE NERVOUS SYSTEM

Compression of the Spinal Cord: The report by Kay and her associates (13) of 34 cases included 2 in which there was spastic paraplegia as a result of compression of the spinal cord. In our series there was neurologic evidence of compression of the cord following pathologic fracture of the vertebrae in 6 cases. Laminectomy had been performed four times on one patient in a period of five years. The operations had been carried out for relief of compression following numerous pathologic fractures of the vertebral bodies. Ultimately, in order to obtain relief from pain, the patient submitted to a fifth operative procedure, which consisted of chordotomy.

Psychosis: In our series, there were 4 cases in which a psychosis was encountered. One of the patients was a woman, aged sixty-two years, who had had delusions with ideas of reference. Another was a man, aged thirty-seven years, who was in a marked paranoid state at the time of his admission to the clinic, while a third was a woman, aged fifty-nine years, who suffered from poor memory, disorientation, and apathy. Marked disorientation was observed in the fourth patient, a man of fifty-eight years.

Mental deterioration of a less severe degree was encountered more frequently, particularly poor memory for recent events. Two of the patients had aphasia and one of these suffered from apraxia.

From the foregoing observations, the mental status of the patients included in this series of cases would appear equivalent to the mental status of people in a similar age group without osteitis deformans.

BIOCHEMICAL ALTERATIONS

Alteration of Chemical Composition of the Blood: Hunter (27) stated that "in Paget's disease the serum calcium and plasma phosphorus are practically normal." Kay and her associates (13) concluded, following an analysis of their cases, that the average concentration of calcium was slightly less than normal, namely, 9.1 mg. per 100 c.c. of serum (normal 9 to 10.5 mg. per 100 c.c. of serum). They found the concentration of phosphorus to average 3.7 mg. per 100 c.c. of plasma (normal 3.3 mg. per 100 c.c. of plasma), which they considered to be a slight elevation. For the concentrations of calcium and phosphorus in our series see Table I.

The most striking alteration in the blood of patients with osteitis deformans is an elevation of the concentration of phosphatase, which was first brought to the attention of the medical profession by Kay (28) in 1929. At that time she brought out the fact that the plasma phosphatase was elevated occasionally to as high as twenty times the normal evaluation. She also emphasized that this enzyme was present in relatively large amounts in cases of generalized diseases of bone (29),

namely, osteitis fibrosa, osteomalacia, renal rickets, adolescent rickets, and infantile rickets. The increase in plasma phosphatase in patients with osteitis deformans was corroborated by Roberts (30) in 1930, while, according to Gutman and others (31–34), there is an increase of the phosphatase activity of the blood in multiple myeloma, metastatic carcinoma of bone, particularly the osteoplastic type, and carcinomatous metastasis to the liver with or without jaundice.

The activity of alkaline phosphatase in the serum was determined in 101 of the cases in our series, in accordance with the method employed by Bodansky (35) and described by him in 1933. The alkaline phosphatase level ranged from 1.3 to 216 Bodansky units (Table I). Higher levels for the serum alkaline phosphatase were found in those cases which were classified roentgenographically as the combined phase than in the sclerotic phase (Table VI). It is logical to assume, from this, that the sclerotic form of the disease is a less active phase than the combined form or that it is an evidence of healing. As has been pointed out previously by Kay (28), Gutman and others (33), and by O'Reilly and Race (36 and 37), a rough proportionality exists between the extent of the disease and the activity of phosphatase.

The determination of the activity of phosphatase is of little value in making a diagnosis in early localized forms of the disease, as the elevation in such cases may be slight or absent. In more advanced cases the roentgenographic evidence of the disease is usually obvious.

Changes of Mineral Metabolism: In osteitis deformans, the skeletal structure is altered considerably, and it is only logical to assume that there will be severe disturbance of the mineral metabolism. Studies of this feature of the disease have been carried out from time to time, the first being made in 1904 by Goldthwait, Painter, and Osgood (38), who reported calcium retention of 6 per cent by a patient who had been observed for seven and a third days. In 1915, DaCosta *et al.* (6) made a complete metabolic study of 2 cases of osteitis deformans. In one of these the disease had reached an advanced stage, while in the other it was in the early stage. In the first case there was pronounced retention of calcium, magnesium, and phosphorus with considerable loss of sulfur. In the other there was less marked retention of calcium, magnesium, and phosphorus with no loss of sulfur. In each instance the amount of calcium excreted in the urine was much lower than normal.

TABLE VI: ACTIVITY OF ALKALINE PHOSPHATASE IN THE SERUM IN 57 CASES OF OSTEITIS DEFORMANS*

Bodansky Units per 100 c.c. of Serum	Cases	
	Combined Type†	Sclerotic Type†
0–4	2	5
5–9	7	9
10–24	9	8
25–49	9	4
50–74	1	0
75–99	1	0
100 or more	2	0
Total	31	26

* The chemical work was performed by the Section on Clinical Biochemistry under the direction of Dr. Osterberg.

† The activity of alkaline phosphatase in the serum in cases of the sclerotic type does not exceed 50 Bodansky units per 100 c.c. of serum.

Changes of Chemical Composition of Bone: Various bones from four patients were analyzed chemically by Locke (39). In every bone analyzed except the clavicle the percentage of organic matter ranged from 42.60 to 48.54 per cent. The organic content of normal bone is about 37.83 per cent. In this group of cases the fat content usually was increased, and the content of calcium and magnesium was less than normal, diminution of calcium being the most marked.

PATHOLOGIC ANATOMY

Gross Anatomic Changes

Following a recent pathologic investigation, Schmorl (20, 40–43) demonstrated changes in the pelvis, sacrum, and vertebral bodies without clinical signs or symptoms comparable to those of the distinct clinical type of osteitis deformans with dis-

seminated or polyostotic involvement. Furthermore, he recognized an earlier form of the disease in which small foci, consisting of thickened trabeculae, were present in the sacrum and the lumbar vertebrae. In some instances, the foci were so small that it was necessary to use a hand lens in order to recognize them at necropsy. The final diagnosis of osteitis deformans in this group of cases was confirmed by microscopic examination. Schmorl (20) also demonstrated, following systematic examination of many skeletons, that osteitis deformans is observed most often in the spinal column and sacrum and in many instances may be confined to these regions. In cases in which the disease was confined to one vertebra, the gross and microscopic appearance of the involved regions was similar in every respect, although of a lesser degree, to that in cases in which the lesions were disseminated. Fairly commonly in those cases in which the disease was confined to one or a few vertebrae or a portion of the innominate bone, clinical evidence was entirely absent.

Schmorl's observations on involvement of bones from the standpoint of pathologic changes are comparable to those in the present study (Table IV). It is to be understood that Schmorl's work was not a controlled study of the frequency of the disease in certain bones. In many instances the presence of the disease was discovered incidentally during the course of a roentgenographic examination of the thorax, genito-urinary tract, gastro-intestinal tract, etc. Examination of all bones was not carried out in all cases.

Schmorl (20) attempted to correlate the earliest localization of the disease with the sites most subject to the mechanical effects of function and trauma. This idea was substantiated by his anatomic studies, which showed the sacrum, that part of the skeleton carrying the entire weight of the torso, to be the most frequent site of involvement. The involvement of any part of the spinal column is also in proportion to the mechanical stress to which it is subjected. The frequent involvement of the bones of the pelvis and lower extremities as compared with those about the shoulder girdle and upper extremities adds further support to this view. As Jaffe (44) pointed out, however, the variation in the frequency with which the condition is encountered in the skull and jaw bones will have to be explained before acceptance of this hypothesis.

Osteitis deformans in the spinal column presents a variable pathologic picture. In accordance with Schmorl's description (20), the spongiosa of an involved vertebra is somewhat thickened and dense and the individual trabeculae appear dull white and lusterless. The trabeculae at the peripheral borders of the vertebral bodies appear to be more closely arranged and denser than those centrally located. The individual trabeculae are thickened and coarse. The marrow spaces in the spongiosa are variable in size, and some of them are increased considerably in dimension. Once osteitis deformans has involved any portion of a vertebra, it soon becomes entirely involved. The degree of softening of such bones may become so advanced that it is possible to cut them with a knife.

Jaffe (44) described a case in which the femur was involved and in which the periosteum was adherent to an underlying spongy cortex. The surface of the bone was irregular in contour and showed evidence of injection; exposure of the cortex disclosed it to be thickened and divided into distinct layers. Spaces were observed in the cortical bone of the femoral head and neck, which were filled with fatty marrow, thus producing cyst-like areas in the roentgenogram. Cyst-like spaces were also present in the shaft of the femur. Freund (45) described similar areas and termed them "pseudocysts."

The medullary cavity of the bone is usually widened in those cases in which there is extensive involvement. Fat-filled marrow spaces are observed in the medullary cavity surrounded by dense trabeculae similar to those already described in the cortex. The appearance of the spaces, as

demonstrated in roentgenograms, is similar to that of a cyst. In some instances the enlarged marrow cavity may extend to the articular end of the bone. In these cases, the bone end plate may be reduced to paper thinness or even be absent in some areas.

Alteration of the articular cartilage of long bones is minimal. When it occurs in osteitis deformans, it usually is secondary to malalignment and deformity. Hypertrophic arthritis may commonly be observed in association with this condition, and, when it is present, the proliferative changes at the margin of the articular surface may manifest microscopic evidence of "Paget's bone" (Freund).

Skull: Thickening of the calvarium, in cases of osteitis deformans, extends almost entirely outward and not at the expense of the cranial vault. The increase in the dimensions of the calvarium results from a deposition of finely fibered bone on the outer table. New bone deposited in this manner becomes transformed slowly into "Paget's bone."

Knaggs (7) described three typical stages of the disease as noted in the calvarium. Increase of size associated with great vascularity is first noted, but this subsides as sclerosis develops. The primary stage, or vascular phase, is characterized by a marked red color as a result of permeation of the new porous bone by a very vascular connective-tissue marrow. In this phase the suture lines are not yet obliterated and the frontal sinuses persist. The next phase of the disease has been termed the stage of "advancing sclerosis" by Knaggs. The outer surface of the thickened bone is smooth but is perforated by many minute apertures. The suture lines may be obliterated and the vascular markings are exaggerated. The bones of the inner table are also finely porous. The third phase has been termed the stage of "complete diffuse sclerosis." In this stage the sclerosis has advanced irregularly across the diploic zone. Recognition of the diploic zone may not be possible, particularly on the lateral aspect of the calvarium. Knaggs (7) also described sharply defined islets of ivory-like bone on the cut surface of sections made through the skull. These islets were definitely demarcated from surrounding porous bone and manifested themselves in the roentgenogram as isolated opacities.

The term, osteoporosis circumscripta, was introduced by Schüller (46), who used it to describe a peculiar affection of the skull characterized roentgenographically by definitely demarcated zones of lessened density in the calvarium. Sosman (47) re-examined one of the cases reported by Schüller and then made a record of the results of the examination of bone obtained from the involved regions by trephination. Sosman's study was the first published account of the relation of osteoporosis circumscripta to osteitis deformans.

The circumscribed regions of osteoporosis demonstrated in the skulls of some patients are with little doubt atypical forms of osteitis deformans (Kasabach and Gutman, 24). Schmorl described 7 cases of what he termed "hemorrhagic infarction" of the skull, which most likely are examples of this form of the disease. In 5 of his cases there was evidence of the disease elsewhere in the skeleton, while in 2 cases such evidence could not be demonstrated. In his description of the microscopic picture he emphasized the engorged blood vessels observed in a fatty or fibrous marrow. He referred to the changes, which suggested vascular stasis but lacked evidence of true thrombosis. He demonstrated a bloody exudate in the marrow even though the marrow cells appeared to be normal. He also pointed out that the bone cells in the periphery of the zone would not take any stain, indicating that they had become necrotic, while adjacent marrow had good staining properties.

Involvement of the base of the skull is observed frequently and may or may not be associated with changes elsewhere in the skull. Serious alteration of the contour of the neural foramina is not common. Knaggs (7) suggested that the increase in size of the vascular foramina may be explained by the pulsation of the vessels within the foramen.

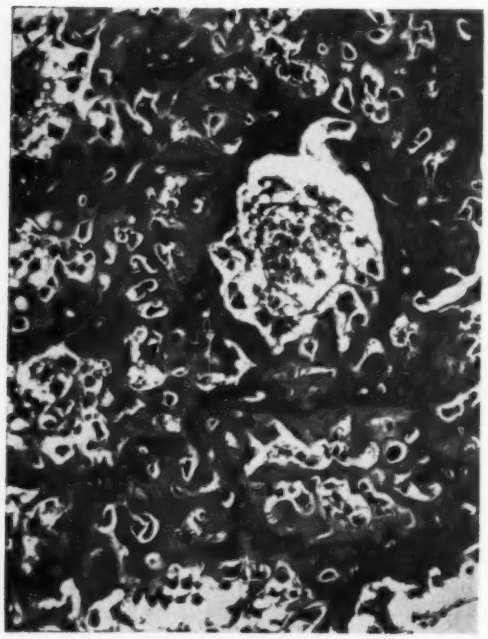


Fig. 7. "Fully developed" osteitis deformans with typical mosaic architecture. Note the fragments of lamellar bone separated by deeply stained cement lines and the absence of haversian systems. ×135.

Bones of the Thorax and Shoulder Girdle: The entire sternum may be involved, but more often osteitis deformans is confined to the manubrium. Involvement of the ribs usually occurs in polyostotic cases and, as Schmorl has pointed out, the disease can be demonstrated most readily at the site of the greatest angle of the rib, that is, in the region of the axilla.

In the clavicle the disease may involve one or the other end of the bone or the changes may be more diffuse. Pathologic changes in the scapula are more likely than changes in the clavicle to be confined to a portion of the bone.

Microscopic Anatomic Changes

We must give credit to Schmorl (20) for clarifying the chaotic histologic appearance of osteitis deformans. According to his findings, the histologic examination of completely and typically transformed "Paget's bone" revealed irregular portions of lamellar bone separated by characteristic deeply staining cement lines. Freund (45) confirmed the demonstration of these deeply-stained lines when the specimen was stained with hematoxylin. He described the typical microscopic picture of completely transformed "Paget's bone" as showing small portions of lamellar bone approximating one another like an irregular mosaic (Fig. 7). Freund emphasized the absence of haversian systems in bone that shows this typical microscopic picture.

Knaggs (7), about the same time and entirely independently, described a similar histologic picture. He commented on the demonstration of "internal curvilinear markings." His paper is well illustrated with photomicrographs which leave little doubt that his description was justified.

The typical mosaic architecture results from an intricate cycle of absorption and deposition of bone (48). Compact bone, spongy bone, and newly formed connective-tissue bone all yield to this pathologic process. The cement lines arise as the result of residue from resorption of bone previously encroached upon and are surrounded by newly deposited bone. Thus, as emphasized by Jaffe (44), the mosaic appearance is an expression of the fundamental process underlying the transformation of the original lamellar bone or the newly formed connective-tissue bone into "Paget's bone."

This typical mosaic architecture can be demonstrated only in completely transformed "Paget's bone." It is not encountered throughout the bone. In some regions, as pointed out by Schmorl, resorption is so rapid that the mosaic arrangement does not form; instead, the original bone may be replaced by connective tissue. The demonstration of mosaic architecture has been made in other diseases but to a much less degree than in osteitis deformans and not nearly so frequently. In osteitis fibrosa cystica a peculiar type of mosaic architecture is noted, particularly about the cysts and brown tumors, but the cement lines are not so irregular as in osteitis deformans.

Jaffe and Bodansky (49) showed that in

experimental chronic hyperparathyroidism the cement lines in bones were numerous but that they were fairly regular in contrast to their great irregularity in osteitis deformans.

The evolution of "Paget's bone" is much more difficult to follow in the long tubular bones than in the flat bones. Schmorl called attention to the fact that the earliest microscopic changes in a long bone are demonstrable several centimeters from the obviously involved cortex. He described the first evidence of the disease as the osteoclasts lying in Howship's lacunae within the vessel canals. As they are invaded by additional osteoclasts and blood vessels, the vessel canals enlarge and, ultimately, contiguous canals fuse and the resultant spaces become filled with connective tissue. Subsequent changes occur similar to the cycle of resorption and deposition described elsewhere.

The process which has been observed primarily in the haversian canals may lead eventually to complete transformation of the cortex into "Paget's bone." Should the process extend farther, it is characterized by periosteal proliferation and by resorption on the medullary side.

Spontaneous healing may be a common occurrence. Florid and healing processes may exist simultaneously in the same bone. Microscopic evidence of the healing process may consist in a recession of the amount of connective tissue. The fibrous marrow may be replaced by a lymphoid and fatty marrow. Additional evidence of healing may be noted in the cement lines, which may become thinner and more regular. In association with this healing process, formation of lamellar bone may be observed on a more normal basis.

PATHOLOGIC FRACTURES

The most frequent complication of osteitis deformans is pathologic fracture (50). In our series this was not so rare as a review of the literature would indicate. Seventy-seven pathologic fractures were noted. They affected 62 of the 367 patients. The most frequent site was in the thoracic and lumbar segments of the spinal column (Table V). All degrees of compression of the vertebral bodies were noted and in many instances there was involvement of multiple vertebrae (Fig. 8). In some cases compression may be due to softening of the bone rather than to pathologic fracture.

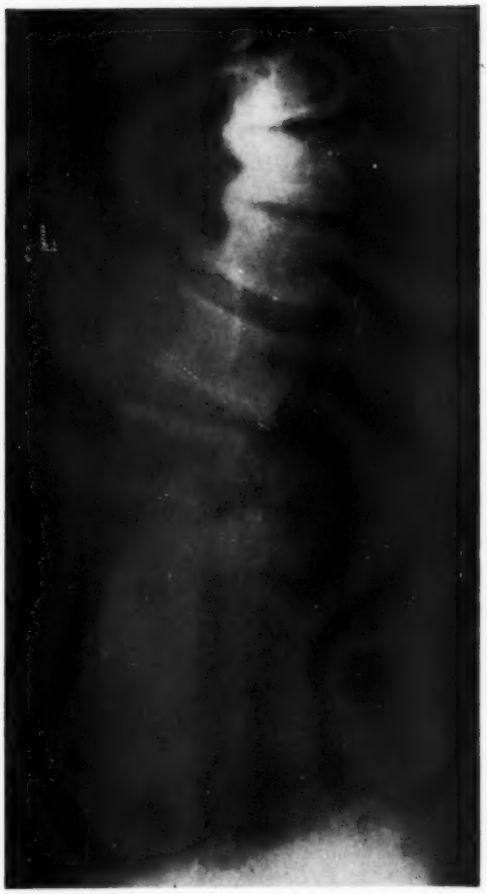


Fig. 8. Lateral view of the spinal column demonstrating extensive involvement by osteitis deformans and multiple compression fractures of the vertebral bodies.

The weight-bearing bones are prone to pathologic fracture and are the next most frequent site of this complication. Transverse fracture without comminution was the type most often encountered; it has been likened to a broken peeled banana. Twenty-nine of the pathologic fractures in

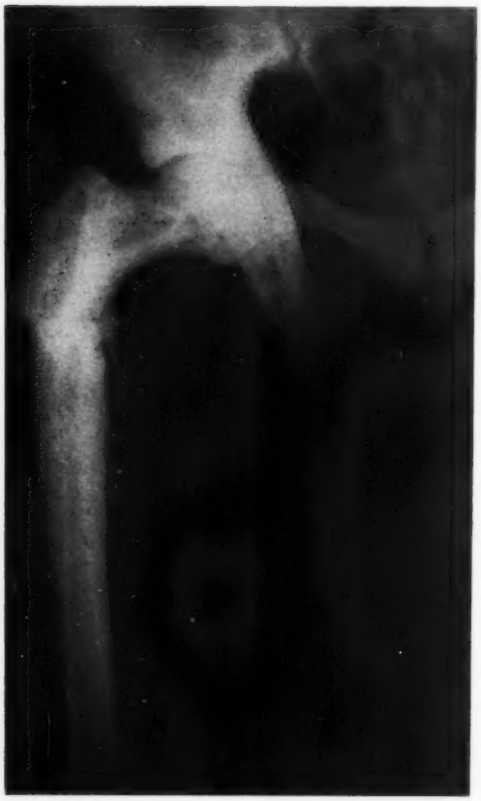


Fig. 9. Anteroposterior view of the right femur, which shows a pathologic fracture, typical of fractures encountered in cases of osteitis deformans.

our series were located in other bones than those of the spinal column (Table V). The most common site in the femur was just below the lesser trochanter (Fig. 9).

Pathologic fracture often occurs following slight trauma and may take place spontaneously. Such fractures practically always heal with an abundant formation of callus, although in some instances delayed union has been encountered. Non-union was noted in only one of the cases included in this series—a fracture in the ischium with considerable separation of the fragments. Traver (51) reported a similar case, although in that instance the fracture was complicated by sarcoma.

As the callus goes through the various phases of calcification and ossification, it can become involved in the pathologic process. Microscopic examination of the callus in some cases revealed evidence of "Paget's bone" (Jaffe, 44).

Incomplete fissure fractures are observed fairly frequently. Seven of this type were encountered in our series, 4 being located in the femur and 3 in the tibia. These are additional to the 77 pathologic fractures previously mentioned. The roentgen picture reveals one or frequently more fissure-like transverse lines of rarefaction on the convex surface of the bone manifesting some degree of bowing. Brailsford (22 and 23), quoting Looser, called such fractures "pseudofractures" and expressed the opinion that they were Looser zones of metaplasia. Following microscopic examination of such zones, Schmorl concluded that they represented true fissures resulting from trauma and were not areas of metaplasia. The mechanical origin of these zones was substantiated by the fact that they were frequently tender and there was a tendency for them to occur on the convex surface of the deformed weight-bearing bone. Allen and John (52) called attention to the fact that ultimately the fissures do one of two things: (1) they may go on to complete transverse fractures or (2) they may heal with minimal formation of callus.

The roentgenograms in 27 of the cases in this series complicated by pathologic fracture have been classified in accordance with the criteria discussed earlier. Twenty-three of the pathologic fractures occurred in cases classified roentgenographically as the combined form and only 4 in the sclerotic form. The observations emphasize the point, as logically would be expected, that less tendency toward pathologic fracture exists in the sclerotic form than in the combined form of the disease.

SARCOMA AND OSTEITIS DEFORMANS

Several isolated examples of sarcoma complicating osteitis deformans have been reported. In 1901, Packard, Steele, and Kirkbride (18) reported 66 authentic cases of osteitis deformans, in 5 of which (8 per cent) the condition was complicated by

sarcoma. In the case reported by Gruner, Scrimger, and Foster (53), osteitis deformans was complicated by formation of multiple sarcomas. DaCosta, in 1915, collected data on 213 cases of osteitis deformans. In 9.5 per cent of this group malignant disease had developed in some form. Speiser (54), in 1927, collected approximately 150 cases, in 6 of which there was sarcomatous change. Bird (55) in reviewing the records of four Boston hospitals, collected data on 64 cases, in 7 of which osteitis deformans was complicated by sarcoma. In 5 of these 7 cases the data were verified by pathologic examination. One of us (Camp, 56) reported 2 cases of sarcoma complicating this condition, seen in the Massachusetts General Hospital. Breslich (57), in 1931, following a review of the literature, presented data on 22 cases of sarcoma associated with osteitis deformans. The ages of the 22 patients ranged from thirty-two to seventy-two years; the average age was fifty-five years. Nineteen of the group were men and 3 were women.

Coley and Sharp (58) studied the problem from a different angle. They collected from the records of the Memorial Hospital and Bone Sarcoma Registry of the American College of Surgeons 71 cases in which osteogenic sarcoma occurred among patients more than fifty years of age and expressed the opinion that osteitis deformans was a predisposing factor to sarcoma in 28 per cent of the number. They concluded that, when osteogenic sarcoma is associated with osteitis deformans, it invariably develops in a bone showing the characteristic changes of the latter disease rather than in a normal bone.

In our study there were 3 instances in which sarcoma, and 1 in which benign giant-cell tumor, was a complicating factor in osteitis deformans. In all 4 cases the disease was polyostotic. The cases were briefly as follows:

1. A woman, aged fifty-two years, had an osteogenic sarcoma arising from the lower end of the left tibia (Fig. 10). Death occurred within a year. The diagnosis of osteogenic sarcoma was confirmed at necropsy.

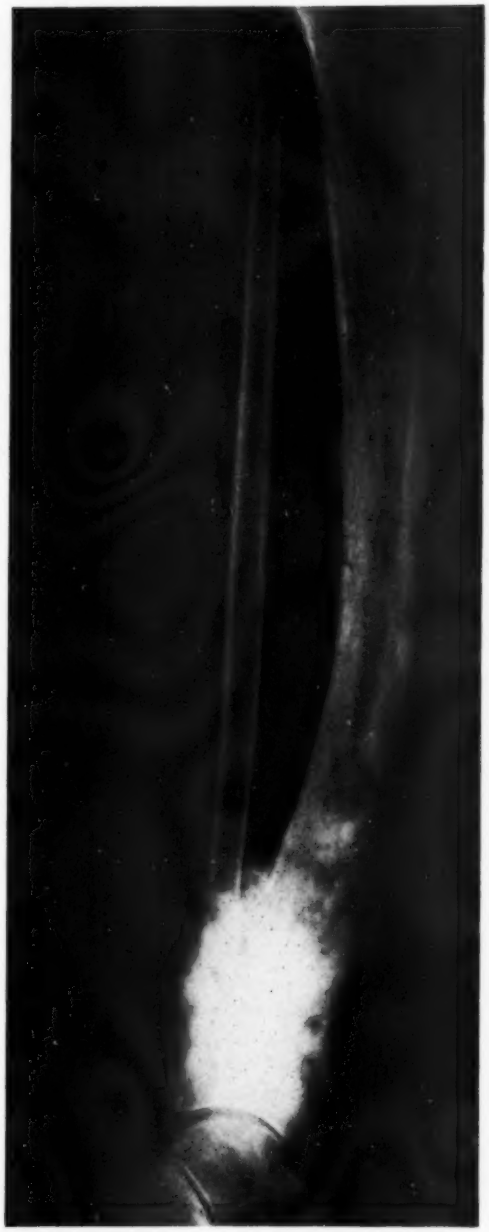
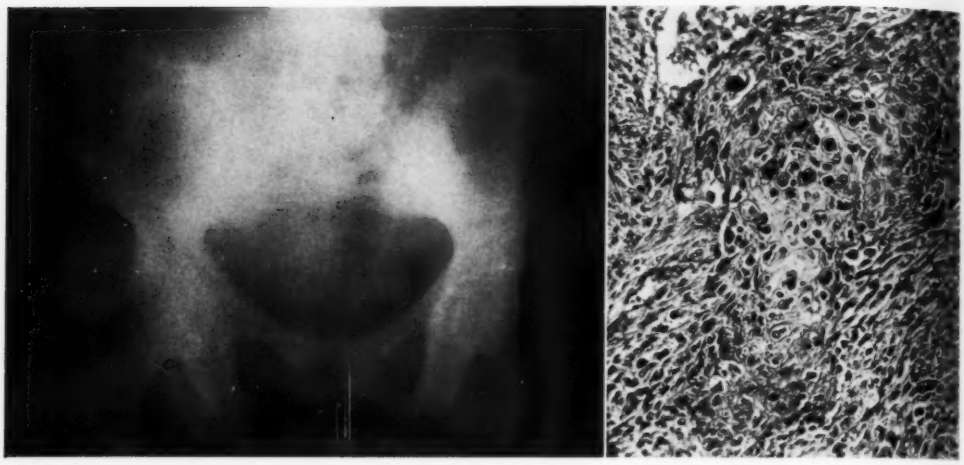


Fig. 10. Lateral view of left tibia. Osteogenic sarcoma involving the lower portion, originating in a bone manifesting the characteristic changes of osteitis deformans.

2. A woman, aged forty-seven years, had an osteogenic sarcoma arising from the right ilium (Fig. 11); the diagnosis was confirmed on examination of tissue removed at biopsy (Fig. 12).



Figs. 11 and 12. Osteogenic sarcoma complicating osteitis deformans. The anteroposterior view of the pelvis shows osteogenic sarcoma originating in the right ilium with characteristic changes of osteitis deformans. In the tissue from the right ilium (osteogenic sarcoma), note the neoplastic cells forming osteoid tissue. Hematoxylin and eosin. × *c.* 125.

3. A man, aged seventy years, had a fibrosarcoma originating in the soft tissue of the left thigh.

4. A man, aged forty-five years, had a giant-cell tumor arising from the left ilium (Fig. 13). Surgical removal of this tumor was performed in 1920 (Fig. 14). A report from the patient sixteen years later stated that there was apparent recurrence of the tumor.

The record of one of the patients in our series stated that a sarcoma of the right maxilla had been excised elsewhere. This patient was aged fifty-seven years.

From the foregoing statements it will be seen that the sarcomatous complications of osteitis deformans usually occur in those cases in which the condition has reached an advanced stage with disseminated involvement of bone. Jaffe (44) has called attention to the fact that a tendency toward sarcomatous change sets osteitis deformans off from other dystrophic bone disease.

URINARY CALCULI

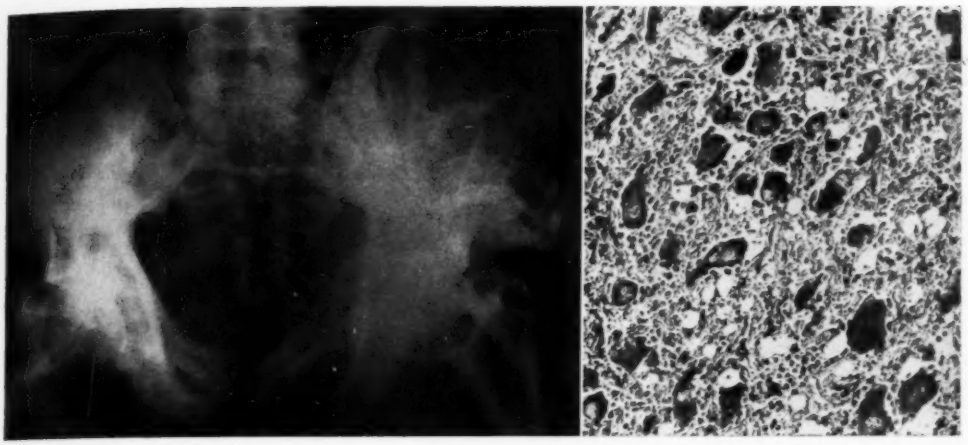
Urinary calculi as a complicating factor in osteitis deformans have not attracted much attention, as is evidenced by the scant reference to the subject in the literature. Twenty-two cases with this condition were encountered in our study. In 11 of the cases the calculi were found in the kidneys, in 7 in the bladder, and in 4 in the ureters. In several instances osteitis deformans was discovered incidentally during the course of the urologic investigation.

Six cases in which urinary calculi were associated with osteitis deformans were reported by Goldstein and Abeshouse (59). They included one case which had been reported previously by Young.

DIFFERENTIAL DIAGNOSIS

In the majority of cases, osteitis deformans is readily identified roentgenographically, even in those cases in which there is no clinical manifestation of the disease. The differentiation from the osteoplastic type of skeletal metastasis, particularly that secondary to adenocarcinoma of the prostate, is a problem frequently encountered. Roentgenographically these two conditions may have a marked similarity. Sutherland (21) called attention to the fact that coarse trabecular striations are usually absent in metastatic lesions. In such cases, also, expansion of the normal dimensions of the bone is uncommon, and destructive lesions are usually demonstrable elsewhere in the skeleton.

Elevation of the activity of phosphatase



Figs. 13 and 14. Benign giant-cell tumor complicating osteitis deformans. The anteroposterior view of the pelvis shows the benign giant-cell tumor originating in the left ilium. Note the extensive changes resulting from the osteitis deformans throughout the pelvic bones. In the tissue from the left ilium (benign foreign body giant-cell tumor), note the numerous giant cells of epulis type. × *c.* 150.

in the serum may be as high among patients who have extensive osteoplastic metastases as it is among those who have osteitis deformans which has reached an advanced stage (31–34).

In some instances osteitis fibrosa cystica (hyperparathyroidism) may be difficult to distinguish from osteitis deformans. Any suspicion of osteitis fibrosa cystica should be confirmed or excluded by chemical and pathologic examinations. In the majority of cases the determination of the concentration of calcium and phosphorus in the serum suffices, although occasionally more complete metabolic studies are indicated.

There have been cases of osteitis deformans in which treatment for syphilitic periostitis has been carried out. The roentgenographic features of syphilitic periostitis, however, are distinct from those of osteitis deformans and should not present difficulty in the differential diagnosis.

Hyperostosis of the skull, such as leontiasis ossea, may simulate osteitis deformans. The serum calcium, phosphorus, and phosphatase are within normal limits in that condition, however, and it is of rare occurrence, with onset of the deformity dating back to childhood (Knaggs, 8).

Non-suppurative osteomyelitis of Garré may present a roentgenographic picture somewhat similar to that seen in cases of osteitis deformans.

Cranial hyperostosis arising from meningiomas, periosteal neurofibromatosis and osteopetrosis all produce roentgenographic changes resembling those seen in osteitis deformans but usually these diseases can be excluded with certainty.

Monomelic flowing hyperostosis or melorheostosis has its onset when the patient is young and usually involves a single extremity.

Benign osteitis of indeterminate origin which is limited to one bone is encountered fairly frequently, particularly in the lumbar segment of the spinal column. Determination of the serum phosphatase is of little value in diagnosis in such cases. Benign osteitis of this type may represent atypical manifestations of osteitis deformans. The benignancy of such lesions should be verified by subsequent roentgenographic examination.

SUMMARY AND CONCLUSIONS

This study is an analysis of data on 367 patients seen at the Mayo Clinic prior to January 1938, for whom there had been a diagnosis of osteitis deformans.

Only once was this condition encountered in a patient less than thirty years of age.

The highest incidence of the disease occurred during the sixth decade, a third of the patients falling into this group.

A definite familial incidence was observed, 16 of the patients having 21 relatives with the same disease.

Seventy-five patients (20 per cent) had no complaints prior to the time of diagnosis and had not been aware of anything unusual so far as the osteitis deformans was concerned. The presence of the disease was discovered incidentally in the course of a roentgenographic investigation.

On the basis of roentgenologic variations, 200 cases have been classified in two groups: (1) the sclerotic phase and (2) the combined phase, 100 cases representing each type.

The most striking alteration observed in the blood of patients who have osteitis deformans is an elevation of the serum phosphatase. Higher levels for serum phosphatase were observed in those cases classified roentgenographically as the combined phase than in those in the sclerotic phase.

Pathologic fracture is one of the most common complications of osteitis deformans. Seventy-seven pathologic fractures were encountered among 62 of the patients included in this series. Pathologic fracture is most likely to occur in those cases in which the condition is classified roentgenographically as the combined phase. Healing with abundant callus nearly always takes place in this group.

In 3 cases sarcoma, and in 1 case a benign giant-cell tumor, was a complicating factor. In each instance the tumor developed in a patient suffering from the polyostotic form of the disease.

Localized or diffuse areas of finely mottled osteoporosis of the skull are thought to be an early roentgenographic manifestation of osteitis deformans (Fig. 4). This condition may be associated with diffuse zones of osteoporosis or minute opacities. In some instances the mottled osteoporosis may be the only roentgenographic evidence of the disease in the skull.

In a study of 117 cases in which there was involvement of the skull, 26 instances of osteoporosis circumscripta were encountered (Fig. 5). Twenty-one of these 26 patients had associated osteitis deformans elswhere in the skeleton. Subsequent roentgenologic examination in some instances demonstrated multiple shadows of increased density typical of osteitis deformans, which appeared in the sharply defined areas of osteoporosis (Fig. 6). From the observations of this study it would seem that osteoporosis circumscripta is an early roentgenographic manifestation or precursor of osteitis deformans of the skull.

Earlier authors held the view that the skull and tibia were the most frequent sites of the disease. In our series of cases, it has been demonstrated that the most frequent site of the disease is the pelvis. This high incidence of involvement of the pelvis—243 out of 307 cases (Table IV)—may be partially accounted for by the frequency with which the diagnosis was made incidentally during the course of urologic examination.

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The Roentgen Appearance of Lobar and Segmental Collapse of the Lung

I. Technic of Examination[1]

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THE ROENTGENOLOGIC demonstration of collapse of the lung and its subdivisions is dependent upon a well planned and well executed technic of examination. It is our intention to review the procedures which have been of significant value in improving the diagnosis of pulmonary lesions. In the majority of patients adequate information may be obtained from fluoroscopy and three roentgenograms: the routine postero-anterior, the Potter-Bucky or Swedish grid, and the lateral. In certain instances, however, more detailed data will be valuable or requisite.

Early diagnosis of any disease process requires the combined advantages of all medical and surgical facilities. Progress in one branch of a science demands corresponding progress in all branches. In recent years, thoracic surgery has made such rapid advances that, in order to keep pace, roentgenologic methods must be constantly reviewed and improved. Accurate localization of a gross pathologic process, as well as knowledge of its nature, clarifies both the indications for surgery and the surgical technic. Preoperative definition of a lesion to an individual lobe, or to a segment of a lobe, is important in the later decision as to the amount of lung tissue which must be saved. Lobectomy rather than pneumonectomy, segmental rather than total lobectomy, has proved feasible and desirable in certain benign processes such as bronchiectasis. This definitive type of surgery minimizes the amount of disability which almost certainly follows too great a reduction in vital capacity. Complete roentgenologic examination of the chest, which includes study of the larger subdivisions of the major bronchi, is therefore essential if the surgeon is to be furnished the details necessary for surgical procedure.

ROENTGEN EXAMINATION

The postero-anterior roentgenogram is the most valuable single part of the examination of the chest. Its value has been proved in large surveys in segregating the normal from the abnormal. It should be used primarily, however, as a scout film, similar to the plain abdominal roentgenogram in pyelography. If it discloses a pathologic process, fluoroscopy should be done, and a Potter-Bucky or Swedish grid as well as a lateral roentgenogram should be taken. If the diagnosis is still obscure, or if surgery is contemplated, study of the chest should be completed. A complete examination is one which gives all the information that is obtainable by roentgenography. It may require, in addition to the foregoing procedures, oblique views, particularly if the lesion is bilateral. Spot films may be as valuable in pulmonary roentgenography, especially of the major bronchi or that portion of the lung in which abnormality is suspected, as they have proved themselves to be in examination of the intestinal tract. Bronchography is of definite but limited value; laminagraphy may give information not obtained by other measures. Stereoscopic roentgenograms furnish little additional data, but they make available two films which demonstrate the chest at slightly different angles.

ROENTGEN TECHNIC

Fluoroscopy: An ideal, not always attained, is that each patient should be ex-

[1] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. One of a series of papers accepted for publication in October 1944.

F 56.3 MASSACHUSETTS GENERAL HOSPITAL

Name: Date: Age: Unit Number:

History:

			R	L	Remarks and Sketches Fluoroscopic Diagnosis
DIAPHRAGM:					
POSITION:	NORMAL				
		HIGH			
		LOW			
OUTLINE:	SHARP				
		INDISTINCT			
		NOT SEEN			
EXCURSIONS:	GOOD				
	(IN CM)	LIMITED (IN CM)			
		ABSENT			
		ABN. SLOW EXPIR. RETURN			
COSTOPHRENIC ANGLES:	CLEAR				
		OBLITERATED			
LUNG FIELDS:	CLEAR				
		ABNORMAL			
HILUM:					
WIDTH:	NORMAL				
		INCREASED			
POSITION:	NORMAL				
		HIGH			
		LOW			
ABNORMAL PULSATION					
HEART:					
SIZE:	NORMAL				
		ENLARGED VENT.			
		AUR.			
		GEN. ENL.			
PULSATION:	NORMAL				
		RAPID			
		SLOW			
	NORMAL				
		SMALL			
		LARGE			
	REGULAR				
		IRREGULAR			
CALCIF					
		PERICARD			
		VALVES			
		CORONARIES			
AORTA:					
SHAPE & SIZE	NORMAL				
		TORTUOUS			
		WIDENED			
PULSATION	NORMAL				
		LARGE			
		CORRIGAN			
MEDIAST:					
POSITION	NORMAL				
		DISPLACED TO			
		INSPIR. SHIFT TO			

CHART I: FACSIMILE OF THE FORM WHICH HAS PROVED SATISFACTORY FOR RECORDING FLUOROSCOPIC OBSERVATIONS AT THE MASSACHUSETTS GENERAL HOSPITAL

amined fluoroscopically. In large surveys, of course, this is not possible, but it can be done subsequent to the discovery of an intrathoracic lesion. The object of chest fluoroscopy is, first, to determine the dynamics; second, to determine the films necessary for the best demonstration of the lesion. Experience at this hospital has shown that fluoroscopy is best done at a relatively high kilovoltage (80 to 90 kv.p.) at 4 ma. for study of the areas of greater density, evaluation of details of the lung fields being left to later study of the roentgenogram. In our fluoroscopic tables the tube is situated approximately 15 inches back of the table top, and the output, as measured in air at the table top, is 18 r per minute. During fluoroscopy, spot films can be taken readily, and these are of great diagnostic value. They are taken at the same kilovoltage at 50 ma. No one particular system of chest fluoroscopy is best, but each examiner should develop a system of his own, whereby he covers all of the important points in the examination.

The following points as to the dynamics of the chest should be noted: motion of the diaphragm, estimated in centimeters, together with any variations, such as paradoxical motion or weakness; the position, size, and type of pulsation of the hilar shadows, which can be readily determined. The type of pulsation of the heart and aorta, as well as the regularity and rate, and the presence of intracardiac calcification, should be observed fluoroscopically, as they are not as easily demonstrated on the roentgenogram. Mediastinal shift in the respiratory phases will also be observed. During quiet breathing, the position of the mediastinum from the point of view of displacement should be noted. In the inspiratory and expiratory phases, actual shift of the mediastinum will signify definite interference with aeration in most cases. In other words, the term displacement of the mediastinum is used to describe its position as seen on the roentgenogram; inspiratory, expiratory, or respiratory shift is applied to its motion as seen during fluoroscopy. Immediately following fluoroscopic examination the examiner should record all his findings on a form furnished for the purpose (Chart I).

Roentgenography: Following fluoroscopy, the requisite films are taken. A postero-anterior projection is necessary in every examination, not only for record but because minimal lesions in the parenchyma of the lung may be overlooked during fluoroscopy and may be discovered only on this film. In certain cases, a roentgenogram in full expiration may give more information than one at inspiration, but its need can usually be determined during fluoroscopy. A lateral roentgenogram should be taken of the patient in whom fluoroscopy or the postero-anterior view has demonstrated abnormality or whose history is suggestive of pulmonary disease. Although the numerous advantages of the lateral view have been stressed in the past (5), it is still not used as often as its value merits. It should be considered one of the minimum requirements in the examination of any patient known to have abnormality in the chest.

An anteroposterior Bucky film allows further study of the bronchi. It permits one to see through dense areas, thus separating a lesion from normal structures. Fluid levels may be seen with the patient in the upright position, and bone detail is more clearly demonstrated. A Swedish grid film supplies all of these advantages but the grid lines are visible. This minor disadvantage is more than compensated, however, by the ease with which the film is obtained.

With the foregoing simple procedures, it is estimated that approximately 80 per cent of patients with pulmonary disease will need no further roentgenologic study to establish a diagnosis. This is particularly true if the modified optimum kilovoltage technic is used.

If the pulmonary lesions are bilateral, or if it is desirable to study the upper posterior portions of the major fissures of each lung, oblique views will often furnish further data. The oblique view may prove as valuable in the study of the lung as it is in

CHEST EXAMINATION (300 ma.; 72 in. distance)						
Size Chest	Postero-anterior		Oblique		Lateral	
	Cm.	Sec.	Cm.	Sec.	Cm.	Sec.
Small	–19	1/70	–23	1/30	–26	1/20
Average	20–25	1/30	24–30	1/15	27–32	1/10
Large	26–29	1/20	31–33	1/10	33–	2/10
Huge	30–	1/15	...	...	...	...
	75 kv.		80 kv.		85 kv.	

CHART II: MODIFIED OPTIMUM KILOVOLTAGE TECHNIC

demonstrating the various chambers of the heart. The left lung field is seen best through the heart in the right anterior oblique, and the right lung in the left anterior oblique view. In the case of bilateral lesions, both oblique views must be taken.

Occasionally a postero-anterior or anteroposterior roentgenogram taken in the lordotic or Fleischner position (3) will define more clearly than other roentgenograms a lesion, such as collapse of the middle lobe, which has its greatest dimension more or less parallel to the plane of the major fissures. The necessity for this film may be determined during fluoroscopy by having the patient assume the lordotic position behind the fluoroscopic screen.

Laminagraphy has a definite place in the study of the chest, to examine the bronchi, to separate abnormal from normal structures, and to localize a lesion. Most of the findings on a laminagram, however, will have been evident before if the preceding methods are properly carried out and are correctly interpreted. Laminagraphy should not be used indiscriminately, as the patient receives a comparatively large amount of radiation (with our equipment, 12.5–13.5 r per 5 exposures, 75–80 r per min.), and it is unlikely that cavities not previously demonstrated will be brought to light.

Bronchography gives valuable information when it is indicated, but its indiscriminate use may frequently interfere with other essential parts of the examination, as well as with future studies to demonstrate any progression or regression of a lesion. It furnishes the most accurate details of the bronchial tree and allows determination of a tumor, stenosis, or bronchiectasis. In bronchiectasis it serves as a map to guide the surgeon in regard to the amount of lung which can be, or must be, removed at operation. It is, however, time-consuming, and in the majority of cases will offer little further diagnostic information than has already been obtained from fluoroscopy and the roentgenograms already discussed.

Adams and Davenport (1) have described the steps necessary for complete examination of the bronchial tree. A satisfactory rule in bronchography is to instill the iodized oil into the bronchi of the involved side of the chest first, after which postero-anterior and lateral roentgenograms are taken. If there is any question of tumor or other type of stenosing bronchial lesion, spot films also should be taken at this time. The opposite side of the bronchial tree is then filled, and postero-anterior, right anterior oblique, left anterior oblique, and Bucky anteroposterior roentgenograms are taken.

Artificial pneumothorax followed by roentgenography, although it constitutes a minor surgical operation, in some cases furnishes information of value sufficient to offset the risk of the procedure. Its use is indicated when it is difficult to determine the origin of a lesion, that is, whether it arises in the parenchyma of the lung, in the mediastinum, or in the chest wall. In the absence of pleural adhesions, the lung will

separate readily from the chest wall or mediastinum, allowing the exact location of the mass to be demonstrated. It is sometimes necessary after the induction of artificial pneumothorax to take antero-posterior or postero-anterior roentgenograms in the lateral decubitus position.

FACTORS AFFECTING THE QUALITY OF ROENTGENOGRAMS

Certain relatively new factors produce roentgenograms of better diagnostic quality than formerly, and they should be used to the greatest advantage. The rotating anode tube, although not particularly new, has in the past ten years proved itself worth while. It allows use of high kilovoltage at high milliamperage with a relatively small focal spot. The higher kilovoltage permits better penetration of the area under examination and more uniform exposure, while maintaining a 6-foot target-film distance. The high milliamperage allows shorter exposure time and minimizes the loss of detail due to motion. The small focal spot aids in giving maximum detail. A phototimer (6), or a device of similar type, may become universal in the future, but at the present time its advantages are somewhat limited. Intensifying screens of relatively small crystal size and cassettes with good contact are recommended. The optimum kilovoltage technic, as publicized by Fuchs (4), can readily be adapted to examination of the chest, and with modifications permits the obtaining of excellent films at 6-foot distance. The higher kilovoltage used with this technic will give a film showing less contrast, but this disadvantage is offset by the production of one in which all parts of the chest are sufficiently exposed for diagnostic purposes (Fig. 1). Lesions in the mediastinum and behind the heart, not visible on a contrast film of the past, become much easier to recognize. Satisfactory lateral projections are also obtained at 6-foot distance with the modified optimum kilovoltage technic, and at this distance better detail is secured and less radiation is scattered. This modification of the optimum kilovoltage technic described by Fuchs (Chart II) has been of significant value in producing films of uniform quality and with great diagnostic potentialities.

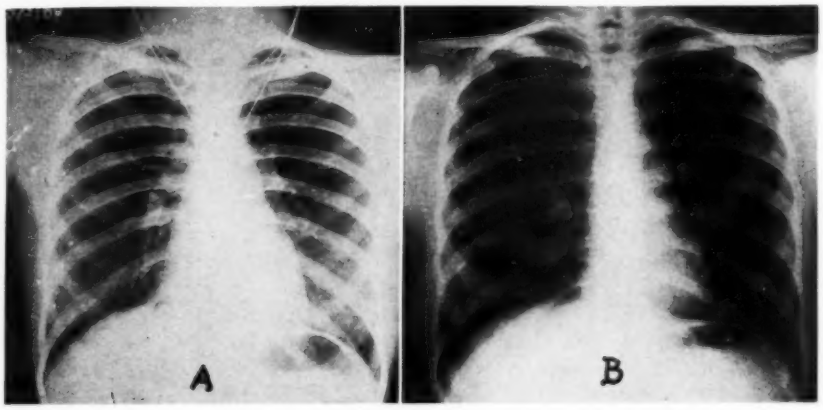

Fig. 1. A. Variation of kilovoltage dependent upon the thickness of the part. B. Modified optimum kilovoltage technic. With this technic, all parts of the chest are more equally penetrated, confusing shadows are lost, and the left lower lung behind the heart is visualized. (Further illustrations of the different diagnostic procedures have not been included because many of them will be demonstrated in subsequent papers.)

SUMMARY

Roentgen examination of the chest, consisting of fluoroscopy and three roentgenograms, is technically easy to accomplish and is economical. Its diagnostic possibilities are manifold, and in the majority of cases it will give all the necessary information.

Certain patients will require additional procedures, which are described.

The importance of the rotating anode tube, of the fundamental factors of good technic, and of utilization of the modified optimum kilovoltage technic has been stressed.

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Bone Lesions of Congenital Syphilis in Infants and Adolescents: Report of 46 Cases[1]

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THE MAIN objective in this review of 46 cases of congenital syphilis has been to analyze and evaluate the roentgenographic findings. The material was collected at the State University and Crippled Children's Hospitals. It includes 19 males and 27 females; 32 white and 14 colored patients. Their ages ranged from the newborn child up to nineteen years. Twenty patients were older than one year, and 26 were younger. Of the latter group, 20 were less than five months of age. Serologic tests were reported positive in 43 cases, negative in 2, and in 1 case the specimen was destroyed. The cerebrospinal fluid was examined 16 times and found positive in only 1 instance. For the sake of brevity, we have intentionally omitted from consideration stillbirths and syphilitic fetuses.

TABLE I: TYPES OF BONE LESIONS

All cases	46
Periostitis	42
Osteochondritis	21
Osteitis	17
Osteomyelitis	11
(Pathological fractures, 5)	
Cases in children under one year	26
Osteochondritis with periostitis	16
Periostitis	5
Osteochondritis, periostitis, and osteomyelitis	2
Osteochondritis	1
Osteochondritis, periostitis, and osteitis	1
Periostitis and osteitis	1
(Pathological fractures, 2)	
Cases in patients over one year	20
Osteitis and periostitis	10
Osteomyelitis and osteitis	3
Osteomyelitis and periostitis	3
Osteomyelitis, periostitis, and osteitis	2
Osteomyelitis, periostitis, and osteochondritis	1
Periostitis	1
(Pathological fractures, 3)	

Although many of these patients were examined in our Outpatient Department and only brief records were available, the following clinical findings were noted: snuffles and skin rashes in 13 cases; pseudoparalysis in 11; adenopathy, enlargement of the liver and spleen in 10; saber shin in 10; keratitis in 3; and draining bone lesions in 2. In 3 patients pyogenic osteomyelitis was suspected; scurvy in 2; Ewing's tumor in 2; osteogenic sarcoma in 1; sickle-cell anemia in 1; Hodgkin's disease in 1; neuroblastoma in 1.

In reviewing the x-ray findings, the bone lesions were listed individually as shown in Table I, although in the great majority of cases a combination of lesions was present. Thus, periostitis could be detected in 42 cases, osteochondritis in 21, osteitis in 17, and osteomyelitis in 11. There were 5 pathological fractures in the entire series. As appears from the table, the most prevalent lesion in very young infants was osteochondritis with an associated periostitis. The incidence of periostitis as the sole lesion was approximately one-third as high. Two pathological fractures were observed in this group. In older children, osteitis and osteomyelitis, associated with lesions of other types, occurred in almost equal proportions. Among these older patients there were 3 pathological fractures.

OSTEOCHONDRITIS

In syphilitic infants of less than one year of age, the pathognomonic lesion seen on roentgen examination is osteochondritis, accompanied in most instances by periostitis. These lesions tend to have a symmetrical distribution, although they vary considerably in appearance and extent. In severe cases the destructive process is so extensive about the growing ends of the long bones that metaphyseal fractures occur. It is this type of involvement that is responsible for the clinical picture of Parrot's pseudoparalysis. In

[1] From the Department of Radiology (John E. Heatley, M.D., Director), University Hospitals of Oklahoma School of Medicine. Accepted for publication in September 1944.

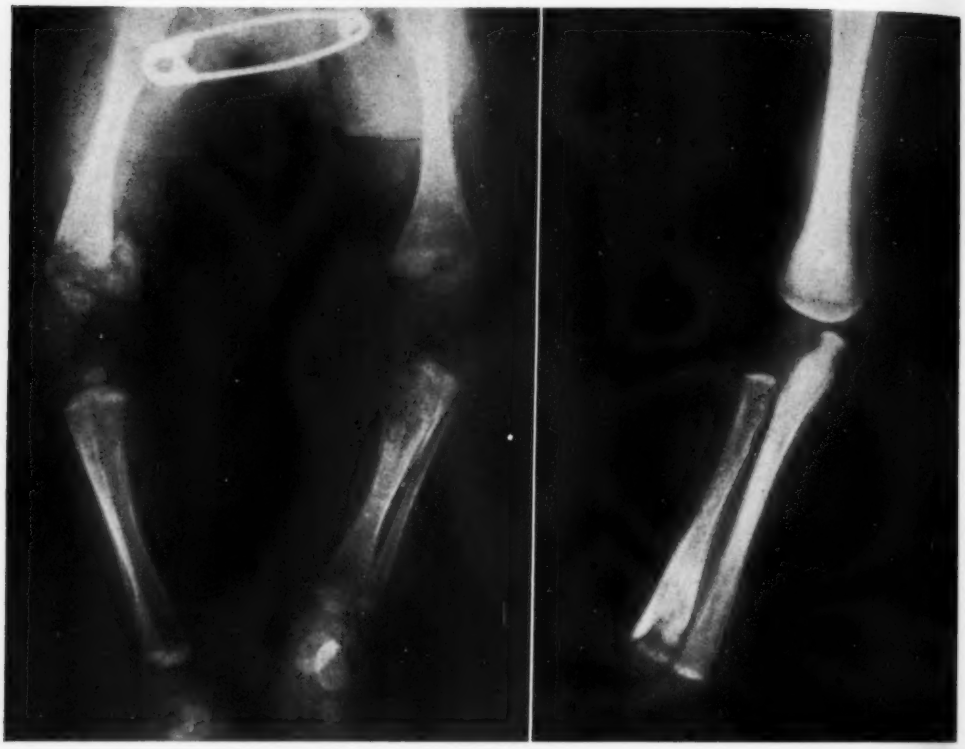

Fig. 1. Case 1: Extensive osteochondritis, periostitis, and osteomyelitis. Dentate appearance of the radial metaphyses, and metaphyseal separation of right femur.

other cases the metaphyses have a "zig-zag" or "saw-tooth" appearance, while in milder cases only a portion of the metaphysis is involved.

All of the above lesions are considered pathognomonic. When, however, osteogenesis is interfered with to a lesser degree, the x-ray findings are considered as merely suggestive of syphilis. If calcium utilization becomes unbalanced, a sclerotic zone or cap is seen at the metaphyseal portion of the shaft. In other cases, a zone of rarefaction develops. In still others a sclerotic zone with an adjacent zone of rarefaction may be found. If these milder cases of osteochondritis are accompanied by a generalized periostitis, the most probable diagnosis is congenital syphilis of bone. In differential diagnosis, birth injuries, rickets, scurvy, and osteogenesis imperfecta must be considered. It is not uncommon for syphilitic babies to suffer from gastro-intestinal disturbances, so that an avitaminosis may coexist. Of the 26 children less than one year of age in our series, 20 gave evidence of osteochondritis of one form or another.

CASE 1: B. J. B., a two-month-old colored girl, was seen because of impaired motion of all the extremities. The onset of these symptoms had been three weeks previously. The mother had received two antisyphilitic injections during the prenatal period. The child's legs were swollen and held flexed on the thighs, and it cried out when any movement of the arms or legs was attempted.

X-ray films of the long bones showed extensive osteochondritis, periostitis, and osteomyelitis involving the tibiae, femora, and radii (Fig. 1). The metaphyses had a dentate appearance and metaphyseal separation had occurred. Blood Wassermann, 4 plus. *Diagnosis:* Congenital syphilitic bone lesions.

CASE 2: R. J. G., a month-old colored male, was brought in because of moderate swelling of the hands

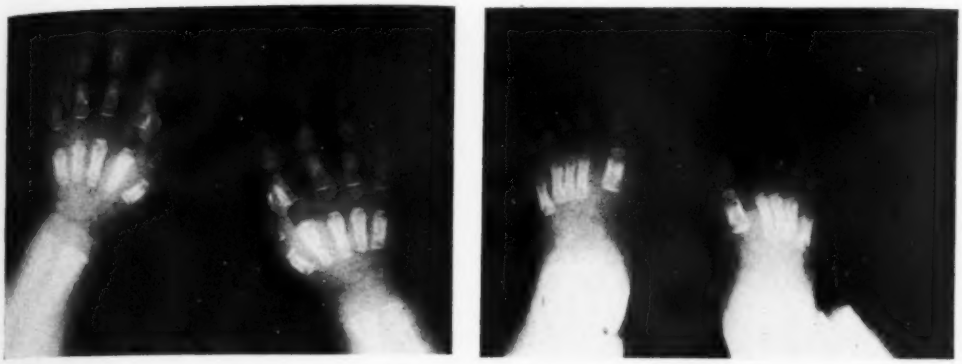

Fig. 2. Case 2: Osteochondritis and periostitis of bones of the hands and feet. The long bones of the extremities showed similar changes.

Fig. 3. Case 3: Generalized periostitis of the long bones of the extremities.

and feet of three days' duration. This was the only positive physical finding. The blood Wassermann reaction was 4 plus. Both mother and father also had positive serologic reactions. X-ray films of the extremities showed osteochondritis and periostitis of the long bones. The hands and feet showed similar changes (Fig. 2). *Diagnosis:* Congenital syphilitic bone lesions.

PERIOSTITIS

Periostitic lesions may occur in young babies as well as in older children and adolescents. Like osteochondritis, periostitis may show considerable variation. In some cases it is seen roentgenographically as a thin linear shadow, or it may be more

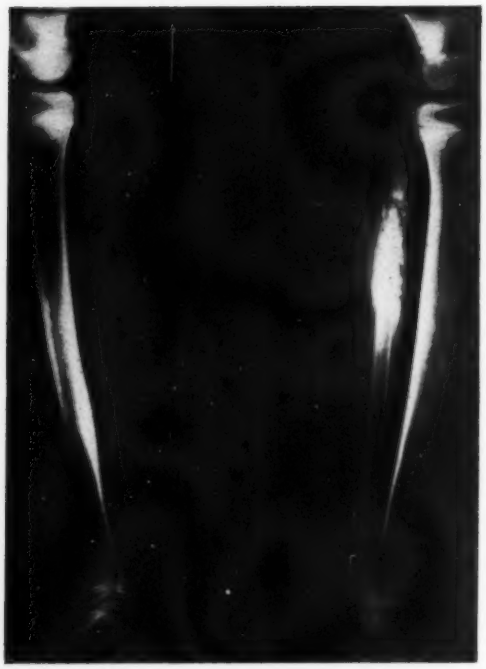

Fig. 4. Case 4: Pathological fracture of left fibula with several layers of periosteal thickening. Osteitis of right tibia.

extensive so that several thick layers are present. In the later cases, it is associated with an underlying osteomyelitis, forming an involucrum, and has been referred to as the coffin type. In 5 cases in our series, all in babies under five months of age, the sole lesion identified on the x-ray films was a generalized periostitis of the long bones. As stated previously, if any type of osteochondritis is present, together with a symmetrically distributed periostitis, congenital syphilis is the most probable diagnosis. In older children, the periosteal reaction may serve only to mislead us. The onion-skin appearance, sharply broken off, perfectly imitating a Codman's triangle, gives one the immediate impression of a primary bone tumor. In such cases x-ray films of all the long bones become invaluable, as an associated osteitis will give a clue to the correct diagnosis. Periostitis was present in 42 of our 46 cases—25 times in children under one year and 17 times in the older group.

CASE 3: K. M., a five-month-old white male, was seen because of convulsive seizures of a week's duration. Physical examination was essentially negative. Films of the long bones showed a periostitis symmetrically distributed, with some rarefaction of the metaphyses (Fig. 3). Blood Wassermann and cerebrospinal fluid tests were positive. *Diagnosis:* Congenital syphilis of bones.

CASE 4: J. G., an eight-year-old colored girl, complained of swelling of the left leg of four to five months' duration, which was painless and progressive. No other complaints were mentioned. Examination revealed erosion of the soft palate and generalized lymph node enlargement. The left foreleg was swollen, edematous, and non-tender. Roentgenograms disclosed a pathological fracture of the proximal third of the shaft of the left fibula with fusiform expansion and thickening of that portion of the shaft (Fig. 4). There were numerous periosteal layers showing moth-eaten spaces. The medullary canal was also involved. In spite of a positive serologic test, a diagnosis of Ewing's tumor was made. Biopsy was reported as favoring a syphilitic infection. Additional films, of the opposite leg, showed an osteitis of the right tibia which brought the x-ray findings more in keeping with the positive serologic reaction.

OSTEOMYELITIS

Although osteomyelitis is occasionally found in infancy, it is more prevalent in older syphilitic children. It may occur as a single lesion or in a more generalized form, as in the pyogenic type. We have limited the term gumma to localized areas of destruction within bones showing an osteitis, realizing that this distinction is purely arbitrary. In any case of syphilitic osteomyelitis, the pathologic process is the same, consisting of invasion and replacement of osseous elements by granulation or fibrous tissue. Pathological fractures occur not infrequently in these cases and often are multiple. In the older children, these lesions are thought to be due either to inadequately treated or untreated bone syphilis of early childhood. In this series only 2 cases of osteomyelitis were found in the group under one year of age; 9 cases occurred in the older children.

CASE 5: L. M., a seven-year-old white girl, was first seen on Jan. 7, 1940, because of swelling of the abdomen and cervical lymph nodes. These symptoms were of several months' duration. This child had been sickly since birth. Six weeks before admission, following a sore throat, the lymph nodes

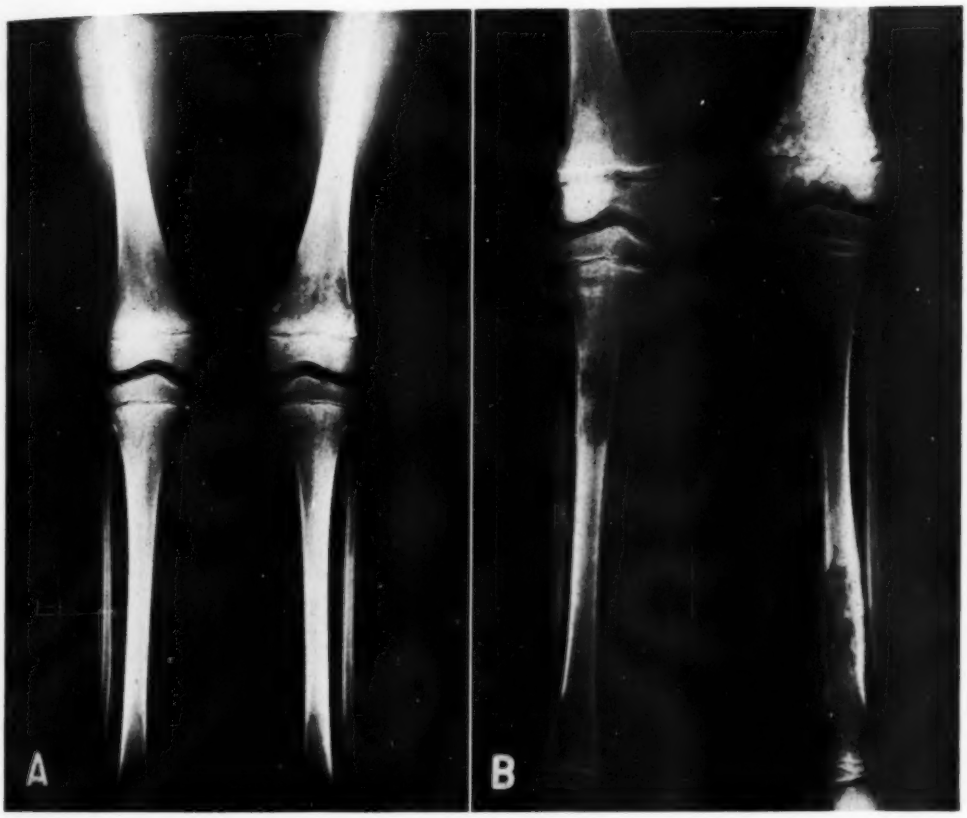

Fig. 5. Case 5. A. Destructive lesions of the left femoral metaphysis (Jan. 16, 1940); the right ulna was similarly involved. In spite of adequate antisyphilitic treatment, the blood Wassermann reaction remained positive. B. Roentgenograms made Oct. 24, 1940, showing bone lesions to be more extensive and numerous. In several bones the epiphyses also became involved.

of the neck became swollen. Pinworms had been found in the stools from time to time for the past five years. At the age of three, the child became blind, but there had been some improvement in this respect.

The child looked anemic, undernourished, and chronically ill. Cervical and axillary adenopathy was present. The liver and spleen were moderately enlarged. The pupils were small and reacted sluggishly to light; the cornea appeared hazy. Clinically, the case was considered one of Hodgkin's disease, leukemia, or tuberculosis. The blood findings were as follows: hemoglobin 50 per cent; red cells 3,600,000; white cells 7,400 (neutrophils 37 per cent, eosinophils 6 per cent, stab forms 27 per cent, lymphocytes 33 per cent, monocytes 2 per cent); platelets 378,000. The blood Wassermann reaction was positive, the cerebrospinal fluid reaction negative. A lymph node biopsy was reported as showing a low-grade fibrosing type of tuberculosis. The chest film revealed moderate widening of the upper mediastinum due to lymphadenopathy, with no evidence of cardiac or pulmonary disease. The long bones of the extremities showed destructive lesions involving the shafts of the right ulna and the distal third of the left femur (Fig. 5, A). Later, similar lesions developed in the neck of the left humerus, crossing and involving the proximal epiphysis, in the distal end of the right humerus, several of the ribs, and both tibiae. Due to the progressive and destructive nature of the bone lesions, with extension into the epiphyses, a diagnosis of neuroblastoma was made. A biopsy specimen taken from the tibia was reported as showing a chronic interstitial osteitis with fibrosis, probably tuberculous or syphilitic. In spite of adequate antiluetic therapy, the blood Wassermann remained positive and the bone lesions became more widespread (Fig. 5, B). Several pathological fractures occurred. When last seen, on Jan. 26, 1941, the patient was up and about on crutches. The liver and spleen had decreased in size and her general condition was im-

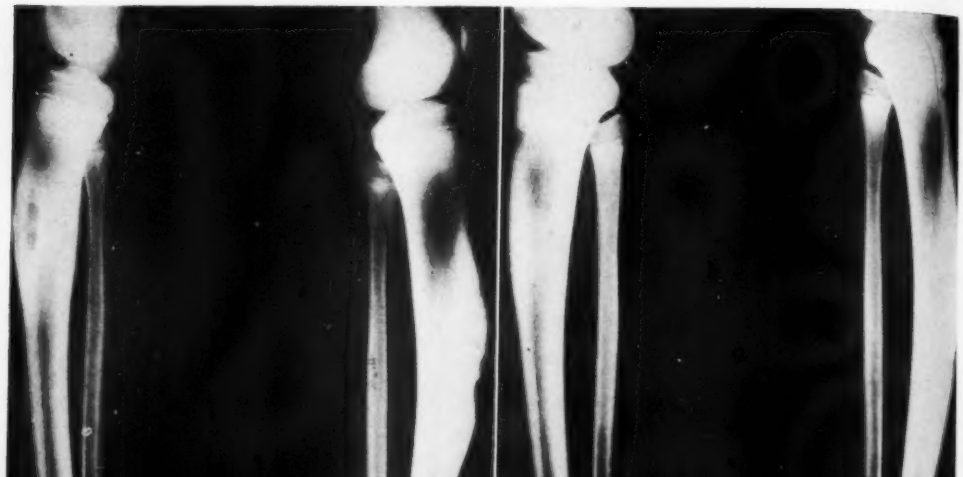

Fig. 6. Case 6. A. Moderate thickening of the cortices of the tibiae, with increased density and anterior bowing; localized areas of destruction due to gumma. B. Regression of gumma following antisyphilitic therapy; osteitis persists.

proving gradually. *Final diagnosis:* Syphilitic osteomyelitis and epiphysitis.

OSTEITIS

Syphilitic osteitis is found almost exclusively in the older child. Although usually bilateral in distribution, it may vary considerably in degree on the two sides and in different bones. The tibiae are most frequently involved and give the clinical picture of saber shins. Among 20 children over one year of age, osteitis was noted in 13. The cortical bone on the x-ray films is thickened and of increased density. As a result of softening, however, an anterior bowing occurs. Osteitis may affect bones of the hands and feet, producing the syphilitic spina ventosa. When localized areas of destruction are found within these areas of osteitis, a gumma or a localized osteomyelitis forms. Under adequate antisyphilitic therapy these lesions heal rapidly, whereas incision and drainage lead to difficulties and embarrassment.

Diagnosis of syphilitic bone lesions in the older child on the basis of the roentgen evidence is more difficult than in young babies. Pyogenic osteomyelitis, scurvy, blood dyscrasias, primary and metastatic bone tumors, may be suspected.

CASE 6: A 16-year-old white boy was examined for swelling of both forelegs. The swelling first appeared over the left shin four months previously, and two months later the right became involved. Physical examination showed rhagadiform skin about the mouth and swelling over the anterior surface of the shins, which was painless on pressure. X-ray films revealed a moderate thickening of the cortices of the tibiae (Fig. 6, A), most marked on their anterior surface, where bowing of the shafts had occurred. A localized area of destruction, surrounded by a zone of sclerotic bone and thickened periosteum, was present in each tibia. Serologic blood tests were positive; the cerebrospinal fluid was negative. *Diagnosis:* Syphilitic periostitis with gumma. Under antisyphilitic therapy the gummatous lesions regressed, but the osteitis persisted (Fig. 6, B).

DISCUSSION

It may be worth while to repeat some of the better known facts concerning con-

genital syphilis of bone. Pathognomonic lesions have been found in fetuses as early as the fifth month of gestation (5). In a newborn child, therefore, roentgenographic examination may reveal typical findings, so that an absolute diagnosis can be made. Syphilitic infants that develop bone lesions do so in the first four months of life and these lesions tend to regress or heal spontaneously after that period (1, 2, 4, 6, 8). The osseous changes can be best examined and studied in the long bones of the extremities. They tend to assume a symmetrical distribution and most frequently involve the tibia, ulna, radius, femur, humerus, and fibula in the order named. The fact that these pathological changes are so clearly demonstrable on films is due to invasion and replacement of normal tissue by granulation and fibrous elements. In very young infants the sites of predilection are those where osteogenesis is most active and this interference with normal bone growth affects the appearance of the metaphyses.

Adequate prenatal antisyphilitic therapy does not insure the mother that her baby will not have syphilis, although the incidence is much lower than when the prenatal therapy is inadequate. The highest incidence is observed in those cases where no treatment at all has been administered (9).

In older children, syphilis becomes the "great imitator" and may simulate any type of bone lesion known. Serologic tests of the blood are positive in such a high percentage of cases that its examination is indispensable in confirming the x-ray diagnosis.

Syphilis rarely involves a single bone. In his criteria for making a diagnosis of a primary carcinoma of bone, Bloodgood includes serologic tests and x-ray examination of the entire skeleton. This applies equally well to syphilitic bone lesions.

It has been shown by many previous and similar studies that the bone lesions of congenital syphilis can be accurately determined by roentgenographic studies and that this method is not excelled even by microscopic examination. Syphilis in its tertiary stage is fundamentally a disease affecting the blood vessels, and visceral changes can be traced to disturbances of the circulatory system. In young infants, syphilitic infection becomes most evident in the growing portions of bones, where circulation is being established as a step in osteogenesis. Osteochondritis develops proximal to the epiphyseal cartilage. At a less rapid rate, bones also grow in width under the periosteal and endosteal layers. Thus, a periostitis may represent disturbances in osteogenesis and may be an initial lesion rather than representing the healing stage of the process, as suggested by McLean (6), or a stripping of the periosteum by a serous exudate formed at the site of osteochondritis, as suggested by Hodges *et al.* (4). Of the 46 cases here analyzed, only 4 failed to show any evidence of periostitis, and in 5 cases, all under one year of age, the sole lesion found was a generalized periostitis. Brailsford (2) states that periostitis appears more often in children after the third month of life. In this series there were 8 children under that age and periostitis was found in all except one, who died on the fourth day of life.

Periostitis is the most frequent type of bone lesion in congenital syphilis, regardless of age, and should be carefully sought, although its detection on films often is an easy matter. A generalized periostitis of the long bones before the age when scurvy and rickets usually develop should be considered syphilitic until proved otherwise. It is important, however, to keep in mind that this same finding may occur in nonsyphilitic lesions. Caffey (3) found it in cases of healing rickets especially in premature infants, rapidly growing normal infants, pyogenic osteomyelitis, erythroblastic anemia, traumatic ossifying periostitis of the newborn, and even in congenital heart disease. In the older child, the periostitis is usually associated with underlying bone disease, such as an osteitis or osteomyelitis. Examination of all the long bones of the extremities in these cases will

help considerably in arriving at the correct diagnosis. It is not unusual in cases of this type to conduct the roentgenographic examination on the same day the blood is obtained for a Wassermann test. The films can be examined shortly after development so that the x-ray diagnosis may precede the serology report by several days, and the diagnosis made so much sooner. By this method, the diagnosis may be established even in cases with negative blood findings.

CONCLUSIONS

1. Bone lesions of 46 syphilitic children ranging from the newborn up to the age of nineteen years were analyzed and studied.

2. The highest incidence was found in infants less than five months of age and the predominant osseous lesions were a generalized osteochondritis and periostitis.

3. Generalized periostitis may be the sole lesion, representing a disturbance in the osteogenesis responsible for the growth in *width* of the shaft of long bones; disturbance of growth in the *length* of the shaft produces an osteochondritis.

4. In children after the first year, osteitis and osteomyelitis were the most frequent lesions found, usually associated with a periostitis.

5. Roentgenographic examination constitutes not only an excellent method for making the diagnosis, but also gives an accurate picture of the type and extent of the bone changes.

6. In suspected cases, films of all of the long bones of the extremities are indispensable.

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Idiopathic Spontaneous Pneumothorax: History of 100 Unselected Cases[1]

CAPT. LOUIS SCHNEIDER, M.C., A.U.S., and I. I. REISSMAN, M.D.

THE WRITERS have been impressed by the frequency with which a history of spontaneous pneumothorax is obtained from selectees in the 18- to 38-year age group appearing for induction examination. About one in five hundred men gave a verified history of this condition.

That so-called idiopathic spontaneous pneumothorax rarely results in pulmonary tuberculosis is now well known (1–4). Many of the men who had suffered such pulmonary collapse in the past, however, were unduly alarmed about it, having been advised unnecessarily to lead a cautious, sedentary life. Some even exhibited functional chest symptoms bordering on conversion hysteria, probably because the physician who treated them for the pneumothorax viewed this accident as a catastrophe and the subsequent existence of the patient as hazardous.

We believe that these cases should be treated like the accidents they really are. Once the patient has recovered, nothing more serious will happen than a possible recurrence of collapse, after which, as a rule, a subsequent attack is uncommon. Invalidism or chronic lung disease is rarely a sequel.

The following data are based on 100 unselected cases of spontaneous pneumothorax observed months to years after collapse. The clinical histories were verified by certified letters from physicians who originally treated the patients and in many instances by x-rays taken at the time of the treatment. One of us (L. S.) carefully reviewed the induction chest films in each case to ascertain the condition of the lungs, keeping special watch for evidences of bullous emphysema and areas of fibrosis or infiltration.

Lung Involved: The right lung was involved in 55 cases, the left lung in 44. One patient gave a history of bilateral pneumothorax.

Age Incidence of Initial Pneumothorax: In no instance was there a history of pneumothorax before the age of sixteen. Twenty-three cases occurred between the ages of sixteen and twenty; 34 cases between the ages of twenty-one and twenty-five; 29 between twenty-five and thirty, and 14 between thirty-one and thirty-five years. The accident would thus appear to be most common in the third decade of life, as has been reported by others.

Recurrences: There were 19 recurrences in this series. Discounting 6 cases in which a spontaneous pneumothorax was first shown on our own films at the time of examination, the percentage of recurrences was about 20.

All except two recurrences were on the same side as the original pneumothorax. There was no recurrence before the age of twenty, and only one beyond the age of thirty. In 7 cases recurrence was within one year after the initial pneumothorax; in 3, two years later; in 1, three years later; in 2, four years later. There was 1 recurrence five years and 1 nine years after the initial attack. Three instances of multiple recurrence were seen: in 1 case, one, two, and three years after the first attack; in 1, two and seven years later; and in the third after several intervals of unstated length. The chance of recurrence appears to be only about 10 per cent if two years have elapsed since the initial pneumothorax.

Activity at the Time of Spontaneous Pneumothorax: As far as could be ascertained, none of these men had suffered

[1] From the Armed Forces Induction Station, Second Service Command, Grand Central Palace, New York, N. Y.
Accepted for publication in July 1944.

from chronic bronchitis, asthma, or pulmonary tuberculosis at the time of the spontaneous pneumothorax. Except for the few who had had colds, all were in good health. In the majority of cases—63—the pneumothorax occurred during slight physical activity. In only 30 did it develop during intense physical exertion, as in lifting a heavy weight or rapid running. Of the 6 men in whom the condition was discovered at the Induction Station, 5 were asymptomatic and were surprised to learn of its presence. The sixth had experienced severe direct trauma to the chest earlier in the day. In some, typical symptoms of sudden chest pain and dyspnea had appeared as they were walking slowly, eating, shaving, sleeping, or standing or sitting quietly. Direct trauma to the chest without rib fracture accounted for 4 cases. The forced expiration of coughing associated with an acute upper respiratory infection was responsible for 6 cases; 1 followed a spell of sneezing; another, an attack of vomiting.

Racial Factors: In this series there were 97 white men, 2 Negroes, and one Chinese. This represented a marked disproportion as compared with the ratio of white to colored men examined at the Station. In one of the Negroes the pneumothorax was asymptomatic and discovered only on the induction film; the other Negro was a hospital orderly. Although we have seen over 200 men with histories of pneumothorax, we have been impressed by the rarity of this accident in the colored race. We have no reason to believe, however, that the occurrence of spontaneous pneumothorax is or should be less among blacks than whites; rather we feel that the former are less sensitive to the symptoms of the condition than the latter, and that, for that reason, the pulmonary collapse goes undetected and unrecorded. There are, of course, some men among both blacks and whites who have no symptoms, like the 5 per cent in whom pneumothorax was first seen at the Station on routine examination. They will run through the gamut of spontaneous pneumothorax to re-expansion without ever being aware of the condition.

X-Ray Findings: Sixty-five men of this series were seen two years or more after re-expansion of the collapsed lung, and some more than ten years later. It is an impressive fact that the chest films in these cases appeared perfectly normal except for 4 instances cited below. In other words, from the appearance of the film, we could not determine whether a spontaneous pneumothorax had occurred in the past, nor could we predict that one would be likely to recur in the future. On the other hand, one of us (L. S.) has seen numerous cases at the Induction Station, of bullous emphysema, some confined to the apex or apices and others involving half the lung field unilaterally or bilaterally, without any history of spontaneous pneumothorax.

The positive findings in the 4 cases in our series were as follows:

1. Bullous emphysema of both apices, more marked on the right side, in a selectee who had had a right spontaneous pneumothorax with recurrence on the right side four years later.

2. Bilateral thickened apical pleura in a selectee who had had partial pneumothorax on the left side four years before.

3. Marked residual pleural thickening in a man who had had a spontaneous hemopneumothorax on the left side two years before. Another man in the series, who had had a pneumothorax three months before, with aspiration of bloody fluid from the left chest, showed no residual pulmonary or pleural changes.

4. Productive lesion at the periphery of the left upper lobe, above L-2, in a man who had had a spontaneous pneumothorax on the right side five years before.

Clinical Aspects and Attitude of Selectee in Regard to Pneumothorax: Complete statistical data as to the clinical aspects of pneumothorax are not available in this series. Pain or a "queer feeling" in the chest and respiratory distress on effort were the outstanding symptoms at the time of the accident. Sometimes, because of the pain, the chest had been strapped

after a diagnosis of pleurisy was made, the true condition being determined later, following roentgenography or fluoroscopy. In not a few instances, especially in the older men, when the pain was in the left chest and associated with distress, a diagnosis of angina pectoris or coronary occlusion was made. The treatment usually consisted in keeping the patient in bed several weeks and allowing him to return to work, presumably after a short period of observation following re-expansion. One man with a total pneumothorax on one side returned to work three weeks after the diagnosis was made, while another, with a one-third collapse of the right lung, was allowed to return to his job four months later. Some went to work within a month after the occurrence of spontaneous pneumothorax while others did not resume their duties for six months to a year. The average length of "disability" was about three to four months. In "compensation cases," as a rule, absence from work was more prolonged. A common complaint of selectees who had spontaneous pneumothorax was occasional dull to sharp pain on the side of involvement, usually not related to effort.

Many of the men had been told—and some brought letters from their physicians to the same effect—that because they had experienced a spontaneous pneumothorax they were not to indulge in exercise, sports requiring exertion, or hard physical labor. Some selectees in whom the accident had occurred many years ago had been thus cautioned lest pulmonary tuberculosis develop. A few, in whom the pneumothorax was of more recent date, were so instructed because of the possibility of recurrence, and many others had been advised to lead an almost sheltered life, without explanation. It was refreshing to see some, however, who had been told to forget about their pneumothorax, once re-expansion had taken place, and to indulge in all normal activities. Not infrequently, a letter from the selectee's doctor urged a cautious, almost vegetable existence, despite the fact that the spontaneous pneumothorax had occurred during no more superhuman physical effort than reading a book, shaving, or sleeping.

ILLUSTRATIVE CASES

CASE 1: *Spontaneous Pneumothorax, Asymptomatic, Discovered at Induction Examination.* A white selectee, aged 36 and in good health, reported for induction examination on Sept. 9, 1943. A spontaneous left-sided pneumothorax with 85 per cent collapse was discovered on the routine chest film. The man was asymptomatic at the time and recalled no undue exertion or trauma to the chest within the preceding days. After routine home care, he returned to work several weeks later. He appeared at the Station for re-examination on Feb. 10, 1944, having no complaints. X-ray examination at this time was completely negative in respect to pulmonary disease.

CASE 2: *Direct Trauma to the Chest and Spontaneous Pneumothorax.* A white selectee, aged 26, appeared for induction on Feb. 15, 1944. On the way to the Station that morning, he got out of his car, slipped on the icy pavement, striking the xiphoid region of the chest against the door handle of the automobile. He was mildly dyspneic and slightly cyanotic but had no chest pain. A routine film showed 80 per cent collapse of the right lung with no evidence of rib fracture. The man's past history in general was negative and he had experienced no previous known spontaneous pneumothorax.

CASE 3: *Spontaneous Pneumothorax Not Following Undue Exertion, with Recurrences.* A white selectee gave a history of his first spontaneous pneumothorax at the age of twenty-five. This occurred while he was getting up from bed in the morning. A complete collapse on the right side was found at that time. He spent one month in a hospital and returned to work two months after the accident. One year later, a second pneumothorax developed on the same side, with pain in the chest and difficult breathing, as the patient was alighting from a car he had just been driving. A third attack occurred a year after that, and a fourth one, two years after the third, while the patient was sitting in his office. When he appeared for induction examination, a year after the last episode and six years after the initial pneumothorax, he was asymptomatic and x-ray examination showed normal lungs.

CASE 4: *Psychosomatic Complaints after Spontaneous Pneumothorax.* A white man, aged 20, was seen for a second induction examination on Feb. 26, 1944. Nine months before, at his first examination as a selectee, a left pneumothorax was discovered on the routine film. During the interval and on the second Station visit, he complained of annoying dull pain in the left chest and said he had been advised to take good care if he would avoid lung trouble. He expressed great anxiety lest he become a pulmonary invalid if he were accepted for military

service and could not be dissuaded from viewing the accident of spontaneous pneumothorax as a disabling disturbance, with dire forebodings.

CASE 5: *Spontaneous Pneumothorax First Treated as Pleurisy.* A white man, aged 33, was walking slowly on the grounds of the World's Fair, when he was seized with pain in the right chest. He went to a doctor three days later; a diagnosis of pleurisy was made and the chest was strapped. Having obtained little relief, the patient consulted another physician ten days after the attack. At this time an x-ray examination revealed 50 per cent collapse of the right lung. Four weeks later the patient returned to work. Three months passed, and he had a recurrence with 30 per cent collapse of the right lung, this episode also taking place while he was walking. This time he was absent from work only two and a half weeks. At the induction examination, four years after the last pneumothorax, the chest film was completely normal.

CASE 6: *Spontaneous Hemopneumothorax, with Subsequent Changes in Lung Fields.* A white selectee, aged 33, gave a negative history up to two years before induction. At that time, while eating breakfast, he was seized with an attack of severe respiratory distress requiring immediate hospitalization. At the hospital, examination revealed hemopneumothorax in the right chest with complete collapse of the lung. Bloody fluid was aspirated from the right thorax several times during a hospital stay of three weeks. The patient returned to work six months after this accident. A film taken at the Induction Station, two years later, showed thickening of the pleura on the right side, with marked retraction of the mediastinal structures to the right.

CONCLUSIONS

1. A study was made of 100 unselected cases of spontaneous pneumothorax of the so-called idiopathic type, which had occurred in selectees for military service months to years before induction examination.

2. This condition occurs most commonly in the age group twenty to thirty years.

3. Spontaneous pneumothorax may appear asymptomatically, as occurred in 5 per cent of this series. From its discovery on routine chest roentgenograms, it may be assumed that this accident is more frequent than clinically supposed.

4. There is no notable predilection for one side of the chest rather than the other.

5. Recurrences take place in about 20 per cent of the cases, and on the same side. Recurrence was uncommon in men over thirty years of age.

6. Spontaneous pneumothorax occurred more often in this series during relatively slight physical exertion or with the patient at rest than following undue physical stress or strain.

7. Roentgenograms of the lungs taken months to years after re-expansion of the collapsed lung were negative in all but four instances. In the great majority of cases, one cannot tell from the film that a pneumothorax ever existed, nor could it be predicted from the film whether or not the patient would sustain a future recurrence. On the contrary, numerous cases of bullous emphysema seen at the Induction Station gave no history of spontaneous pneumothorax.

8. Many of the men were unduly apprehensive as to the possibility of future complications—recurrences and sequelae.

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A Case of Arterial and Periarticular Calcinosis of Unknown Etiology[1]

LT. COL. JOSEPH LEVITIN, M.C., A.U.S.

THE FOLLOWING case is one of unusual widespread arterial calcification associated with calcium deposits about the joints of the extremities.

A soldier attached to combat troops, age 24, with nineteen months' service in the Army, gave no antecedent history related to the present illness. Prior to service in the Army, he had worked in a nursery in the state of South Carolina. He was admitted to the hospital because of swelling, tenderness, and stiffness of the joints of both hands and stiffness of the right knee. These symptoms had come on gradually two weeks before admission.

The outstanding point of interest in the family history was that one brother had been discharged from the Coast Guard on account of "swollen joints." The patient's mother and father were both living and well, as were four sisters and two other brothers.

Physical examination on entry into the hospital showed swelling about the joints of both hands. The swellings were not hot or tender, and there was no limitation of motion. The radial arteries at the wrist and the tibial arteries at the ankle were palpable, irregular, and hard. Blood pressure was 160/110, being the same in both arms. The thyroid was not palpable, but bilaterally in the submental region an irregular hard mass could be felt.

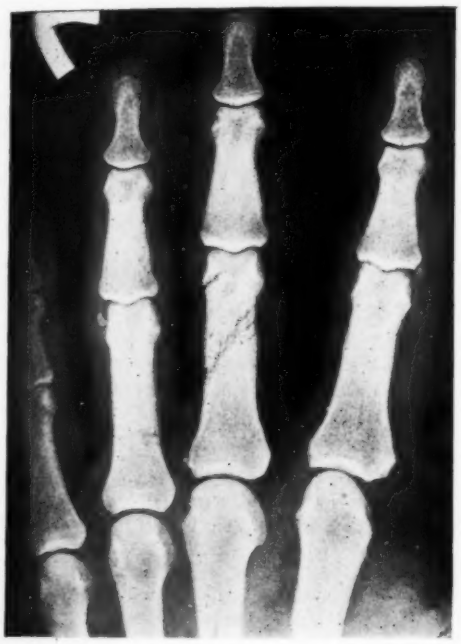


Fig. 1. Periarticular calcification of the interphalangeal joints of the hand.

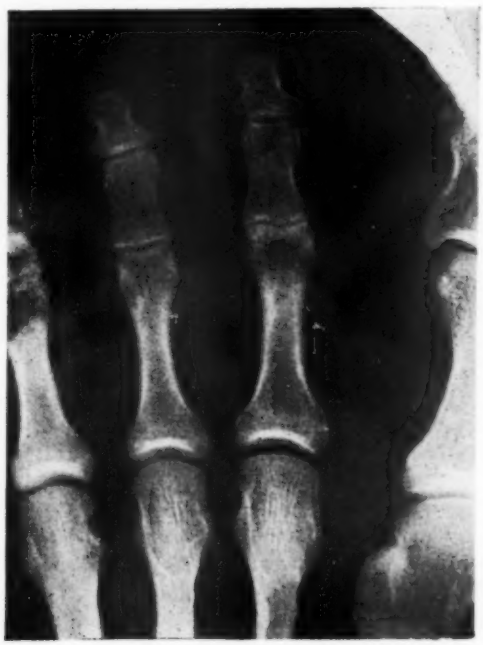
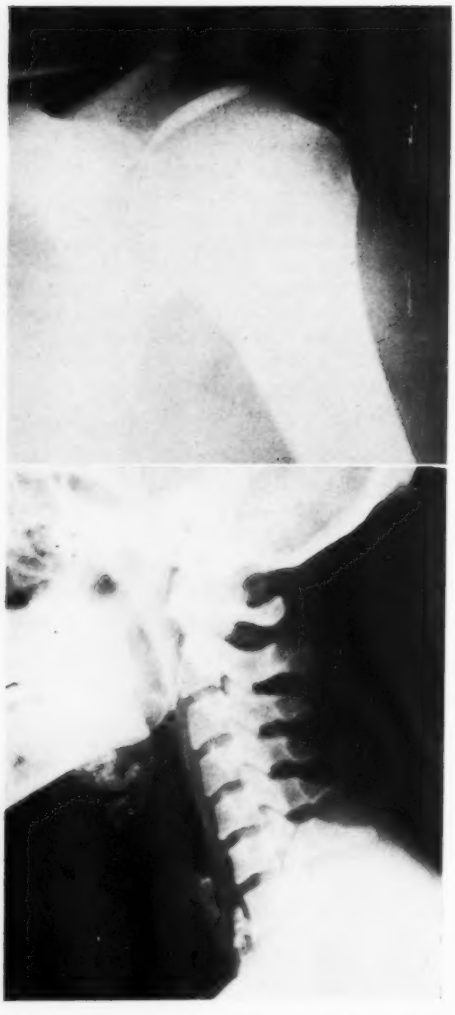


Fig. 2. Pariarticular calcification of the interphalangeal joints of the foot.

X-ray examination showed a most unusual picture. The hands (Fig. 1) and feet (Fig. 2) showed small calcium deposits about the interphalangeal joints; a small calcium deposit was seen about the elbow joint and calcium deposits were present in the subdeltoid bursae of both shoulders (Fig. 3). There were no complaints referable to the feet, elbows, or shoulders. Further films of the skeleton showed an extensive calcification of the middle-sized arteries. In the neck (Fig. 4) could be seen the common carotid artery, the superior thyroid, the lingual, and the internal carotid. The lingual artery was tortuous, dilated, and irregular, accounting for the palpable mass in the submental region. A chest film showed the heart to be normal in size and shape. There were

[1] Accepted for publication in July 1944.



Figs. 3 and 4. Calcification in the subdeltoid bursa and calcification of the common carotid, superior thyroid, lingual, and internal carotid arteries. The lingual artery is tortuous, widened, and palpable as a hard mass.

no calcifications in the thoracic aorta or in the pulmonary vessels. In the abdomen, the iliacs were partly calcified and there was extensive calcification of the renal arteries (Fig. 5) and of an aberrant renal artery on either side. Another calcified vessel (the inferior phrenic) (Fig. 6) was seen above the renal vessel on the left side. The abdominal aorta was not calcified except for that part which lies between the origin of the phrenic and renal vessels. The femoral artery (Fig. 7) was demonstrated bilaterally and could be followed to the popliteal and the division into the peroneal and posterior tibial. X-ray examination of the feet (Fig. 8) demonstrated the anterior tibial, dorsalis pedis, and the first metatarsal dorsalis. In the forearm only a small part of the ulna artery showed calcification.

The x-ray appearance of all the bones of the extremities, spine, and skull was normal, with no suggestion of demineralization. It is to be noted that the calcification of the vessels was layed down not in streaks but in the form of irregular plaques. Furthermore, the vessels were elongated, and in some instances widened and tortuous.

Examination of the retina showed no sclerosis of the retinal arteries or vascular abnormalities.

To identify the calcified vessels as arteries rather than veins, a venogram was made following injection of 20 c.c. of 35 per cent diodrast into a small vein of the foot (lateralis marginalis), with a tourniquet applied high on the thigh. The films (Figs. 9 and 10) obtained showed the diodrast to be in the saphenous, popliteal, and femoral veins, and the calcifications to be in the arteries.

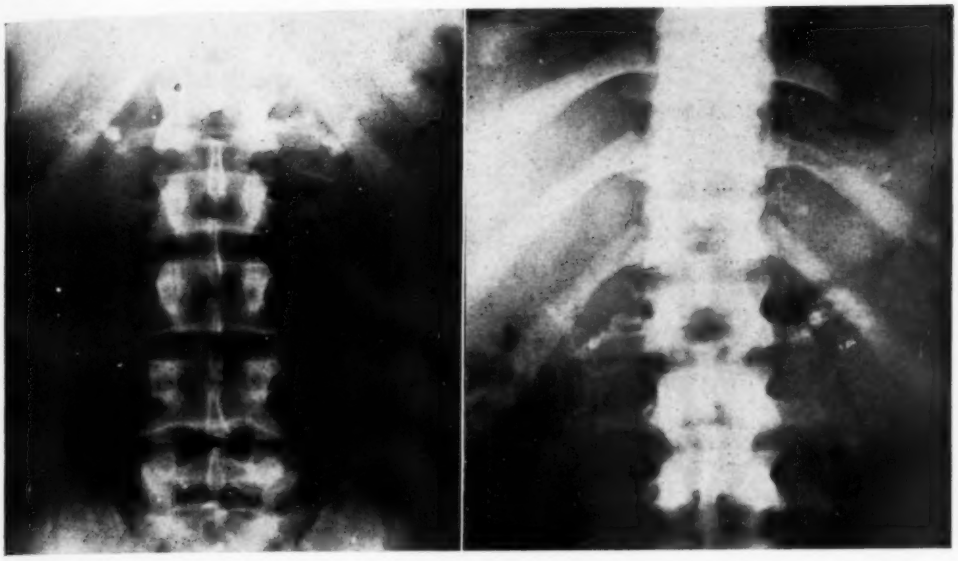
The diodrast also served the purpose of an intravenous pyelogram (Fig. 11). The kidney calices, pelves, and ureters were well outlined and of normal contour. The kidneys showed normal function, being well shown five minutes after injection. An interesting observation was the pressure deformity of the left kidney pelvis due to the renal artery, giving the so-called "derby hat deformity" sometimes found with an aberrant vessel (personal communication from Col. V. Mason).

Laboratory studies threw no light on the etiology or nature of the disease. The blood count was normal. The urine had a specific gravity of 1015, with a range of 1.008 to 1.028. No albumin, casts, or sugar were present. The Kahn test was negative. The blood chemistry was normal: non-protein nitrogen, 28 mg. per cent; creatinine, 1.2 mg. per cent; uric acid, 3.6 mg. per cent; cholesterol, 159 mg. per cent; serum phosphatase, 3.5 Bodansky units; serum calcium, 11 mg. per cent; serum phosphorus, 4.1 mg. per cent; glucose tolerance tests, fasting, 88 mg. per cent, 2d specimen, 137 mg. per cent, 3d specimen, 140 mg. per cent. The sedimentation rate was 3 mm. in one hour (Cutler).

A biopsy was performed, with removal of a small piece of the posterior tibial artery. The report by the pathologist, Major Cares, was as follows:

"*Gross:* Fresh section of artery 3 × 4 mm., which on palpation contains numerous calcium fragments. No definite lumen is seen grossly. On section, a fibrous substance interspersed with yellow, chalky granules is seen.

"*Microscopic* (Fig. 12): Some adventitial fat is adjacent to the thickened adventitia containing a number of recent nutrient vessels. Two small but definite plaques of calcium are located in the outer adventitial tissues. The bulk of the artery is composed of distorted, almost intermingled media and intima which are the seat of irregularly encapsulated calcium bodies. The muscular fibers of the media show incomplete replacement fibrosis and atrophy



Figs. 5 and 6. Fig. 5 (left) shows calcification of the renal and aberrant renal arteries on both sides. The renal arteries are widened and tortuous, and the calcium is laid down in plaques. Fig. 6 (right) shows calcification of renal arteries on both sides and the inferior phrenic artery on the left. The abdominal aorta is calcified on the left lateral wall. This represents the only calcification in the aorta.

over a large segment. The lumen is represented by a small channel lined by intermittent projecting clumps of calcium salts. The intima, as above mentioned, contains besides the calcium bodies an irregular, broad zone of granulation tissue and capillaries, with some scattered fibroblasts and histiocytes.

"The bizarre calcified patches contain amorphous, deeply acidophilic hyalin bodies or granules of variable size, which are generally imbedded in the plaque.

"An elastica van Gieson discloses incomplete destruction of the internal elastica, the residue showing splitting. There are only vestiges of an external elastica. The fibrosis demonstrable by the van Gieson is diffuse, involving even the sector of media seen in H. and E.

"A Gomori calcium stain emphasizes the spheroid nature of the calcium plaques, with the medial mass of amorphous tissue staining in mixed acidophilic and basophilic manner. No cell structures are discernible. In this particular section, the location of the calcium plaques is mainly intimal and medial, with a thin, fibrous, surrounding wall.

"*Diagnosis:* Diffuse arterial calcinosis (atypical Mönckeberg's sclerosis)."

The Army Institute of Pathology also reviewed the slides and could not add to the diagnosis. Their report is as follows: "We can add very little to your diagnosis. We thought that some of the calcification may have taken place in old thrombus material in the vessel lumen. There seem to be structures which suggest recanalized lumina."

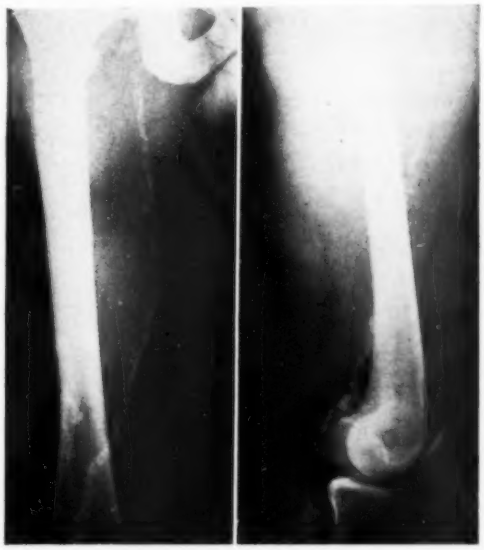


Fig. 7A. Calcification of the femoral artery. See also Fig. 7B.

The patient showed no change in status during his stay in the hospital. The biopsy was without ill effects to the extremity. The joints remained stiff and painful, and transfer was made to a Veterans' Hospital for further care.

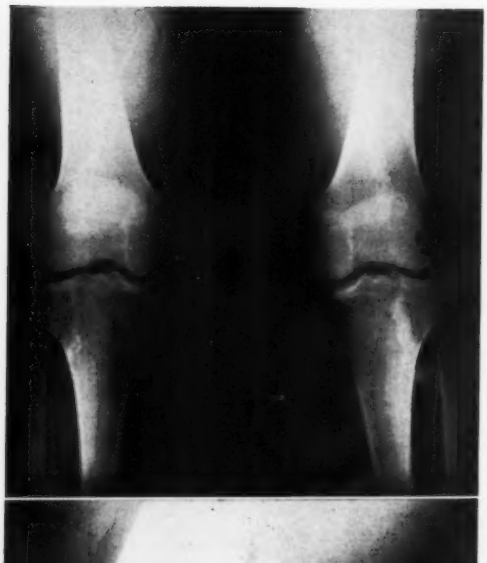


Fig. 7B. Calcification of the femoral artery, popliteal, peroneal, and posterior tibial. Observe the calcium laid down in plaques and the elongated vessels.

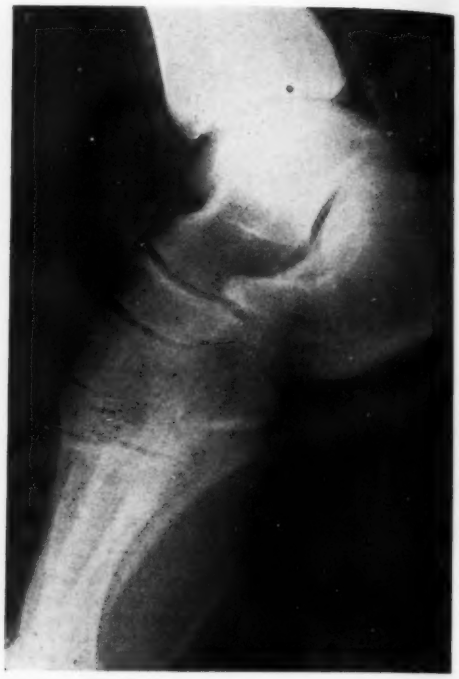
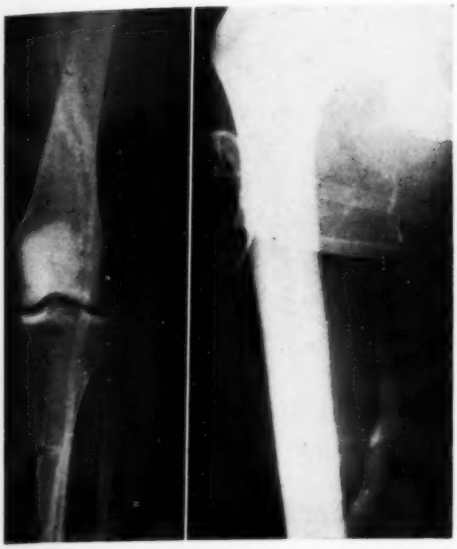


Fig. 8. Calcification of anterior and posterior tibial arteries, the dorsal metatarsal, and the communicating arteries. A biopsy specimen was taken from the posterior tibial artery.

DISCUSSION

This patient presents an unusual picture of an extensive calcification of the medium-sized arteries. It is this type of artery in which the media is the predominating layer. The calcified vessels did not incapacitate him in any way. He had no vascular disturbance of the extremities. It was the joint deposits which brought him to seek medical attention, his complaints being stiffness and tenderness of the joints of the hand and stiffness in one knee. The blood pressure was high for a man of his age, as would be expected in view of the marked calcification of the renal vessels. However, there was no impairment in kidney function as demonstrated by intravenous pyelography or by the blood chemistry.

Considering the fact that the vessels involved were those with smooth muscle of the media predominating, one must first think of a Mönckeberg sclerosis (1). This type of sclerosis, described by Mönckeberg in 1903, seen in the fourth and fifth decades, consists of necrosis and massive calcification of the media with little or no change in the intima. It is most common in the lower extremities. It does not produce



Figs. 9 and 10. Venograms demonstrating saphenous, popliteal and femoral veins lying next to calcified artery.

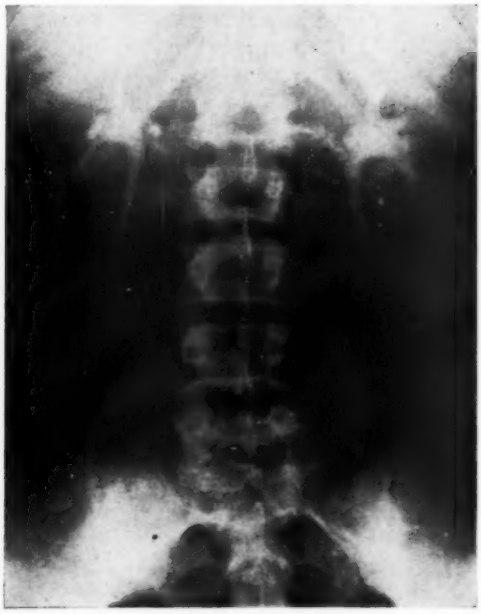


Fig. 11. Intravenous pyelogram made 10 minutes after injection of 20 c.c. of 35 per cent diodrast, demonstrating normally functioning kidneys, with normal contour. The left kidney pelvis shows a pressure deformity caused by the renal artery (so-called "derby-hat" deformity).

vascular occlusion, as the calcification usually fixes the vessel in its largest diameter. It is not associated with a hypertension. The roentgen picture shows linear parallel (streaking) calcification. Against a diagnosis of Mönckeberg sclerosis in this case are the patient's age (there are no senile changes), hypertension, and the x-ray appearance, which shows the vessels to be widened, tortuous, and elongated, with irregular plaques. Biopsy also showed the calcification to be in all the layers.

Atherosclerosis is mentioned only to be excluded. This occurs in the larger and smaller vessels with well developed intima. It is just these vessels that were not involved. The large vessels, thoracic and abdominal aorta, were not affected except for the small patch in the abdominal aorta. The retinal arteries were normal. Enlargement of the left ventricle, frequently associated with atherosclerosis, was not present in this case.

A healed periarteritis cannot be considered, as this disease affects the small arteries, leaving the larger ones intact. Another point against this diagnosis is that the patient had no history of any earlier illness with inflammatory lesions of the arteries.

None of the above-mentioned diseases would account for the calcium deposits about the joints.

Albright, Drake, and Sulkowitch (2) reported a case of renal osteitis fibrosa cystica. Their case and this one have many features in common, but their patient had, in addition to the calcinosis, a marked renal insufficiency and bone changes of osteitis fibrosa cystica. A similar complaint brought the patient to the hospital —painful swellings of the fingers of short duration. X-ray examination in each instance showed calcium deposits about normal joints. The vessels in their case also showed an extreme degree of medial calcification; in addition, there were changes in the retinal arteries, which were narrowed and sclerotic, and calcification in the arch and descending aorta. Their patient also had a hypertension. The

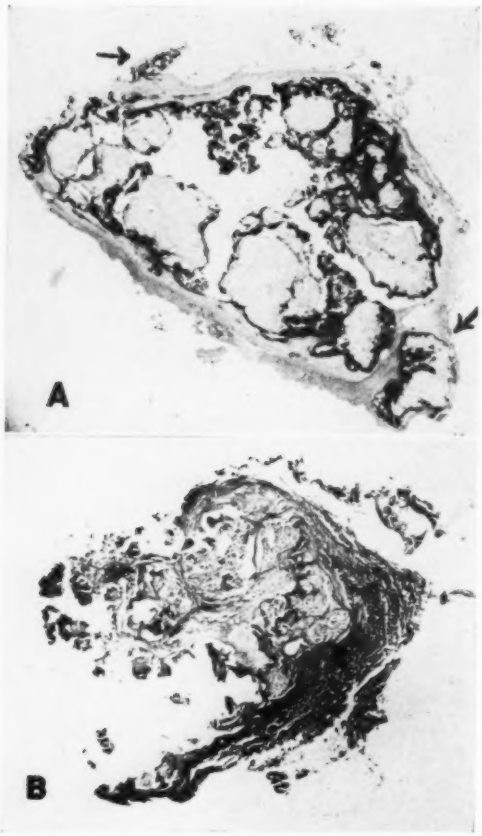


Fig. 12. Microscopic sections of posterior tibial artery. A. Gomori stain. Note relationship of irregular plaques (calcium salts stain black) to intima. The walls have undergone irregular fibrotic atrophy. Note calcium in the adventitia, the larger plaque showing calcium deposition in neutral fatty areolar tissue. ×18.

B. Elastica van Gieson stain. The wall is partly disrupted. The arrow points to the remnants of the internal elastica. There are several recanalized areas in the intimal plaque. On the fringe are darker staining calcium masses. ×16.

case differed from the one here presented in the severe degree of renal impairment.

The phenolsulfonphthalein test in Albright's case showed less than 5 per cent excretion in three specimens at fifteen, thirty, and sixty minutes. On intravenous pyelography, very little of the dye was excreted. The urine showed large amounts of albumin. The blood chemistry also showed abnormal changes: non-protein nitrogen, elevated, 120 mg. per cent; uric acid, 4.4 mg. per cent; blood sugar, 112 mg. per cent; fasting serum inorganic phosphorus level elevated to 9.8 mg. per cent; serum calcium level depressed to 8.2 mg. per cent; serum phosphatase elevated to 9.4 Bodansky units.

The case also differed from the one recorded here in that roentgenograms showed generalized decalcification of the skeleton and the skull had a thin moth-eaten appearance, characteristic of hyperparathyroidism. The absence of bone changes and lack of renal insufficiency precludes classification of our case in the group described by Albright *et al.* For the time being, the case will be designated as "extensive arterial calcification, etiology unknown, with calcium deposits about the small joints of the extremities."

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Duodenal Obstruction Due to Tuberculous Lymphadenitis[1]

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IT IS WELL KNOWN that widening and varying degrees of compression of the duodenum may be caused not only by lesions occurring in the head or body of the pancreas but also by masses of enlarged regional lymph nodes (1–3). Widening of the duodenal curve has been seen as a result of metastatic carcinoma, lymphosarcoma, Hodgkin's disease, tuberculosis, and infectious mononucleosis (5 and 6). In the case to be described, severe constriction and partial obstruction of the duodenum were observed with relatively little widening of the duodenal curve. This finding has not been reported previously in connection with tuberculous lymphadenitis.

CASE REPORT

E. S., a 23-year-old colored youth, was first seen at The Mount Sinai Hospital (Medical Clinic, OPD) in April 1942, complaining of anorexia, postprandial epigastric pain, vomiting, and progressive weight loss. His illness dated back about two years. In December 1940, he had entered Bellevue Hospital because of six months of anorexia, asthenia, low-grade fever, night sweats, bilateral pleuritic pain, and a non-productive cough. Here he was found to have a right pleural effusion, but there was no roentgen evidence of parenchymal tuberculosis, nor were acid-fast bacilli found in the sputum or gastric contents. Patch and Mantoux tests were negative. The patient, nevertheless, was considered to be suffering from pulmonary tuberculosis and was transferred to Triborough Hospital, where he was placed at bed rest for six months, during which time the effusion resolved. Here, too, attempts to prove a tuberculous etiology were unsuccessful. After the resorption of the fluid, however, questionable enlargement of the hilar nodes was observed roentgenographically. A low-grade fever was still present on discharge.

Almost immediately following his departure from the hospital, on July 19, 1941, the patient began to experience sharp, cramp-like epigastric pain, appearing two or three hours following meals, nonradiating and relieved by alkalies and vomiting. He became progressively weaker, lost about 15 pounds, and continued to run a low-grade fever. In April 1942, he was seen at the Medical Clinic of The Mount Sinai Hospital. A gastro-intestinal series at this time revealed a 50 per cent retention after six hours and a constricting lesion involving the pylorus, duodenal bulb, and proximal part of the second portion of the duodenum. These findings were so unusual for a youth of his age that the patient was asked to return for a second examination. In the meantime he was placed on a Sippy diet. He failed to reappear and neglected to follow the diet prescribed.

One year later the patient returned to the clinic because of progression of symptoms. Vomiting was now the chief complaint, beginning about one hour after a meal. The gastro-intestinal series was repeated (Figs. 1 and 2). Retention at the end of six hours was now 75 per cent; constriction of the second portion of the duodenum was increased, and there was slight constriction at the duodenojejunal angle. There was evidence of stasis in the lower part of the second portion of the duodenum and upper part of the third portion. A pressure deformity on the greater curvature side of the antrum and a slight widening of the duodenum were also present (Fig. 1). Because of these findings, the patient was referred to the hospital for study.

He was emaciated and appeared chronically ill. Physical examination revealed no unusual findings in the heart, lungs, or abdomen, and no lymphadenopathy. The temperature was 101° F. Blood examinations showed a hemoglobin of 55 per cent and white cells numbering 5,350 with a normal differential count. The sedimentation time was eighteen minutes compared with a normal of sixty minutes. A guaiac test of the stools for occult blood was negative. Patch and Mantoux (1–1,000 O.T.) tests were also negative, and the gastric contents and sputum failed to show acid-fast bacilli. Urinalysis, electrocardiography, and roentgen examination of the chest and abdomen showed nothing unusual. A Rehfuss test meal revealed normal acidity, and gastric aspiration showed a considerable six-hour residue. A third gastro-intestinal series again revealed the abnormalities previously seen, and the report was: "duodenal obstruction due to a retroperitoneal process in the region of the head of the pancreas."

From the onset, the diagnosis of peptic ulcer was discarded because of the history and the roentgen changes. Three possibilities were entertained: tuberculous lymphadenitis, abdominal lymphoma (Hodgkin's or lymphosarcoma), and carcinoma of the head of the pancreas. The roentgen appearance

[1] From the Department of Radiology and the Department of Surgery of The Mount Sinai Hospital, New York, N. Y. Accepted for publication in August 1944.

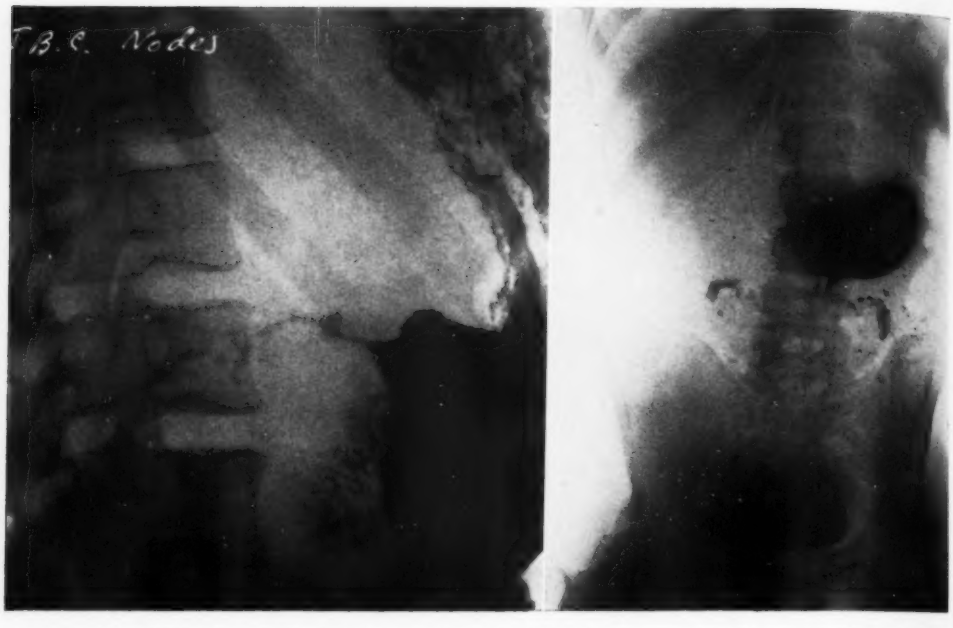

Fig. 1 (left). Marked constriction of the second portion of the duodenum and slight constriction of the duodenal-jejunal angle. A pressure deformity is seen on the greater curvature side of the antrum with considerable deformity of the duodenal bulb.
Fig. 2 (right). Retention of barium (75 per cent) at the end of six hours.

was compatible with a malignant neoplasm in the head of the pancreas, but the very slow progression of the lesion under observation, as well as the continued absence of jaundice in the presence of such marked structural deformity, made such a diagnosis unlikely. Hodgkin's disease and lymphosarcoma could not be excluded. Certainly the history of pleural effusion in a Negro suggested a tuberculous infection. Abdominal tuberculous lymphadenitis was considered as the tentative diagnosis. The absence of calcification and of tuberculin sensitivity was not felt to militate against this opinion.

Surgery was undertaken to relieve the obstruction, to improve nutrition, and to establish the diagnosis. At operation numerous fine adhesions were seen in the region of the liver and the duodenum. The entire retroperitoneum was boggy and edematous. In the gastrohepatic and gastrocolic ligaments, as well as beaded along the duodenum, were soft, greatly enlarged lymph nodes. The severe inflammatory reaction undoubtedly contributed greatly to the constriction observed in the second portion of the duodenum. The antrum of the stomach was thickened and edematous. A gastro-enterostomy was performed and a lymph node was removed for study. The pathological report was hyperplastic tuberculosis with no caseation. No acid-fast bacilli were found. Following an uneventful postoperative course, the patient was discharged, still febrile but without gastro-intestinal symptoms. He was sent to Seaview Hospital, where a protracted convalescence was planned.

DISCUSSION

This case is of interest in the first place, because it represents a type of tuberculous disease uncommon today; in the second place, it presents a pathological process, the roentgen appearance of which may be confused with that of carcinoma of the head of the pancreas.

Prior to the Great War, the incidence of tuberculous infection of the mesenteric and retroperitoneal lymph nodes was rather high. It has been reported that involvement of these nodes was seen postmortem in 50 per cent of children dying of or with tuberculosis in 1918. The diminished incidence in this country, to the point of rarity, has never been fully explained. It parallels the disappearance of cervical tuberculosis. Opie (7) believes it to be a result of eradication of bovine tuberculosis through sanitation and pasteurization.

Abdominal lymphatic tuberculosis is a protean affliction, recognition of which depends upon a history of tuberculous infection, the presence of symptoms of systemic tuberculosis, and objective x-ray and laboratory evidence. Calcification demonstrated roentgenographically is helpful, but unfortunately this is seen in only about 40 per cent of the cases. Tuberculin sensitivity rarely is of assistance in differential diagnosis because it is usually minimal or absent. Symptoms are usually due to the pressure of matted nodes or bands of adhesions constricting an abdominal viscus. Cases have been reported in which there was confusion with acute appendicitis, renal calculus, cholecystic disease, peptic ulcer, and intestinal obstruction. The cases of obstruction hitherto reported have been chiefly in the ileum, occasionally in the jejunum.

Except for conditions such as foreign bodies, calcification, etc., which are seen upon the ordinary x-ray film, the roentgen diagnosis of disease of the pancreas depends almost entirely on the presence of a pressure defect in the barium-filled stomach, duodenum, or transverse colon. It is well recognized that a sufficient enlargement of the head of the pancreas or the regional nodes, if near enough to the barium-filled bowel, will produce some evidence of pressure, such as widening of the duodenum, diminished caliber of its lumen, changes in the direction or destruction of the mucosal folds (8).

From the foregoing description it can readily be seen that many types of masses in the region of the head of the pancreas may produce similar defects and that differential diagnosis at times is difficult or even impossible. There are, however, a few helpful criteria. Many authors feel that if there is marked irregularity of the mucosa of the second portion of the duodenum, the diagnosis of carcinomatous infiltration can definitely be made. It is of interest, therefore, that this case presented all the usual criteria associated with carcinoma, namely, constriction and destruction of the second portion of the duodenum and little widening.

CONCLUSIONS

1. An unusual case of duodenal obstruction due to tuberculous lymphadenitis is presented.

2. The usual criteria for diagnosis of carcinoma of the head of the pancreas may be produced, also, by inflammatory nodes in this region.

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Jejunal Intussusception through a Gastro-Enterostomy Stoma[1]

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INTUSSUSCEPTION through a gastro-enterostomy stoma has been reported many times in the literature of surgery, but we find little reference to this condition in roentgenological literature. The symptoms in the following case correspond well with those presented in the several case reports that have come to our attention.

W. B., aged 47, male, was referred to our office by Dr. M. E. Steinberg for gastro-intestinal x-ray examination, April 20, 1943. He complained of intermittent attacks of pain in the left epigastrium occurring periodically since performance of a gastro-enterostomy in 1931. He had previously had an operation for a perforated gastric ulcer in 1930. At times the pain was relieved by food. There was no history of gastric hemorrhage or blood in the stool. X-ray examination was reported as follows:

"A barium meal was given and the esophagus was normal. The barium entered the stomach in the normal fashion and passed readily to the pars media. At this point the barium divided into two streams and it was thought at first that the lower stream represented barium leaving the stomach by way of the gastro-enterostomy stoma. However, a few inches beyond the point of deviation the two streams met again and joined into one column in the antral portion of the stomach, leaving a large irregular 'island' defect in the gastric lumen which was free of barium. The stomach was freely mobile and no mass could be felt, but the patient was extremely tender to pressure over the defect.

"The barium began to leave by way of the pylorus and the first portion of the duodenum. The cap showed some deformity but no gross defects could be seen.

"As more of the meal was taken, the barium took the same course as above described until the defect became obliterated by the overlying barium. When the stomach was filled, the defect could be demonstrated by pressure over the area. At no time during the examination was any barium seen to leave the stomach via the gastro-enterostomy stoma.

"Serial radiographs failed to reveal the defect but showed evidence of irregularity and considerable irritability of the pyloric antrum and the cap. There was no evidence of barium escape through the stoma.

"*Impression:* There is an encroachment upon the gastric lumen, either by a hyperplastic mass on the posterior wall of the stomach which occludes the stoma or a defect caused by extrinsic pressure of some adjacent structure, such as the pancreas. This examination should be repeated for further study of the stomach. A gastroscopic examination would be of considerable value in obtaining further information."

The patient was admitted to the Emanuel Hospital May 1, 1943, with the following history.

"This patient was operated upon for a perforated gastric ulcer in 1930. A gastro-enterostomy was done in 1931. Since this last operation the patient has had a continuous pain in the upper left side of the abdomen, increasing in intensity during the last few years. At times the pain was relieved by food; at other times taking of food made it worse. Six weeks prior to his admission to this hospital, while at stool he experienced an intense pain and feeling of distention in the lower left side of the abdomen. Upon clutching his left side he felt a rounded mass 'about the size of a hand-ball.' He passed another loose stool and then a third stool within the hour. During this defecation the pain was so intense that he fainted. When the physician arrived about one hour later, the patient was free of pain or distress and the abdominal tumor had disappeared."

At operation, May 6, 1943, by Dr. M. E. Steinberg, adhesions were found between the omentum and the anterior peritoneal wall. The gallbladder was adherent to the duodenum. The pyloric end of the stomach felt thickened and irregular. The gastro-enterostomy was on the posterior wall of the stomach. Approximately 10 cm. of the distal jejunal loop was found to be invaginated into the stomach (retrograde invagination of the jejunum). The jejunal loop was pulled out of the stomach, but it immediately invaginated upon itself and entered through the stoma again. Approximately three-fourths of the stomach, including the thickened area of the pylorus and a part of the duodenum, were resected. A retrocolic gastrojejunal anastomosis was accomplished according to the Finsterer technic of the Billroth II method. The old opening in the jejunum was utilized for the anastomosis.

After the stomach was opened the pyloric opening was found to be very narrow and there were several radiating scars on the lesser curvature border of the antrum near the pylorus. There was also a flattened serpiginous area of ulceration about 2.5 cm. in diameter along the mid-portion of the lesser curvature.

The patient made a good recovery

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[1] Accepted for publication in April 1944.

EDITORIAL

American Medicine Tomorrow[1]

In his excellent book comparing the theories of Oswald Spengler and Raymond Pearl, *Today and Destiny*, Edwin F. Dakin expresses a truism that is of particular significance for doctors in these dynamic times: "Any concept—economic, political, or cultural—which leaves its possessor wholly unprepared for tomorrow is of doubtful validity. Conversely, men who are not surprised when the future comes, lie very close to the truth."

President Lowell S. Goin was pleading for a true concept of the future when, in a recent letter to Members and Fellows of the American College of Radiology, he warned of impending social changes that would almost certainly result in new methods of distribution for medical services. He urged radiologists to actively encourage voluntary prepayment plans for medical care, sponsored by medical societies, as the soundest and most desirable method among the many that have been proposed. At the same time, he warned that some form of socialized medicine, embodying compulsory health insurance, is not an inconceivable eventuality.

Doctor Goin's concern would seem to be justified by what most observers have recognized as an increasing pressure of public opinion. The attitude of the public was succinctly expressed by *Fortune* magazine in its December issue: "The state of medicine in the United States is a social problem because the country's conscience has made it so . . . people who cannot find or pay for proper medical care are resentful."

I have been sharply criticized in some quarters for a statement made in my Annual Report to the Board of Chancellors two years ago, in which I referred to the powerful social forces at work throughout the world and their manifestation in agitation for socialized medicine in this country. I remarked that there was a growing conviction among medical men that a head-on opposition to this unmistakable trend would be as unwise as it would be futile. Subsequent events have proved, I believe, that the demands for improvements in the distribution of medical services must be met, either by voluntary plans for prepayment or, if not, then by compulsory health insurance. It seems unnecessary to recite the extensive evidence that this is so. A half dozen public opinion surveys have revealed a definite public demand for insurance against medical costs.

Brigadier General Fred W. Rankin, in his presidential address before the American Medical Association House of Delegates last year, called upon the medical profession to recognize the gathering momentum of trends that are "directed toward some form of national health service as an integral function of the state." He made a plea that they be regarded not in the light of apostasy, but rather in the light of realism.

Dr. Alan Gregg, whose words carry considerable weight in the medical world, has uttered a similar warning. "The danger for medicine in America lies in failure to acknowledge and to study the sociologic aspects of medicine—the social matrix. We are loath to see that research and teaching, as well as the practice of medicine, will change when change comes in the prevalent interpretations of the role

[1] Presented as the Annual Report of the Executive Secretary to the Board of Chancellors of the American College of Radiology, Chicago, Ill., Feb. 8, 1945. Published in part in certain state journals.

of government and the structure of our society," he says.

It would appear, therefore, that if we are not to be unprepared for tomorrow, we should give consideration in our deliberations to the likely effects of all the various proposals for changes in the economics of medicine.

In our efforts to peer into the future of medical practice in the United States, I think we should keep one very important point clearly in mind. It is this: Every system of compulsory health insurance in all the countries of the world has been built upon existing agencies for the distribution of medical care. On the basis of history, therefore, we can assume that, if a system of compulsory health insurance is adopted by Federal or State governments in this country, existing plans for the application of the insurance principle to payment for medical care will be utilized by the state. The obvious corollary is that medical practitioners would carry on under the state plan much as they did under the voluntary plans which preceded it. This has been the almost universal experience in European systems.

Writing on the "Origins of Health Insurance," in their excellent book on that subject, Simons and Sinai show that compulsory health insurance is built out of three existing institutions: insurance or prepayment plans, the state, and the medical profession. "The relations, reactions, and relative strength of these determine much of the character and results of the operation of existing insurance systems," they say. Their study of compulsory health insurance throughout the world leads them to conclude that pre-existent voluntary prepayment plans have dominated the state systems which followed.

Douglas and Jean Orr, in their book on the British experience with health insurance, point out that the form which the national health system of England finally took was determined by the "Friendly Societies" which had existed for many years as voluntary plans for prepayment to meet the costs of sickness.

Sir William Beveridge, in his epoch-making report on social insurance in England, observes the part which the voluntary plans have played in setting the pattern of the government system. He contemplates, though with frank displeasure, that they will continue to be utilized as distributing agencies in the expanded system which will undoubtedly be adopted in Great Britain. He implies, incidentally, as have others before him, that voluntary sickness insurance promotes, rather than deters, the adoption of compulsory systems. In 1909, David Lloyd George pointed to the "Friendly Societies," which were comparable to our present prepayment plans, as proof of the feasibility and desirability of compulsory sickness insurance. The National Health Insurance Act came three years later. It is significant, perhaps, that efforts to enact compulsory insurance laws in our own country are today most concentrated in the two states with the oldest and largest voluntary medical service plans, California and Michigan.

We all hope that voluntary prepayment plans, sponsored either by medical societies or commercial insurance carriers, will meet the palpable demand of the public for relief from the unpredictable financial burdens of illness. If they do not, the lessons of history teach us that organized medicine has yet another compelling reason for extending these plans as rapidly and as widely as possible. Once firmly established, they would set the pattern and determine the methods to be followed in the event a compulsory system is adopted.

This is a matter of the very greatest importance for the doctors of America. It is surely unnecessary to remark, for instance, that the future of radiology will largely be determined by its status in voluntary prepayment plans, whether or not these plans are later superseded by a compulsory system.

Now, in the light of these considerations, the group hospitalization movement, concerning which organized medicine has been exceedingly circumspect, acquires a new importance that tends to justify medicine's

diffidence. Are the Blue Cross plans to duplicate the history of England's Friendly Societies? Two facts lend credence to an assumption that this is altogether possible.

First, a determined effort is being made by directors of Blue Cross plans to extend their benefits to include complete surgical or medical care. Second, Blue Cross plans would almost certainly be preserved and integrated in a compulsory sickness insurance plan.

The first of these statements will be promptly denied by Blue Cross leaders. But the facts speak for themselves. In Delaware, the Blue Cross plan has already been expanded to include cash benefits for surgical care. It is administered by a Board of Trustees on which there are two hospital representatives for every doctor. Also, in West Virginia and North Carolina, hospital service plans have assumed full control of medical care plans.

The American Hospital Association, at its recent annual meeting, considered recommendations from several speakers for "extending prepaid hospital plans to cover outpatient care." At the same meeting the Hospital Service Plan Commission approved a proposed model enabling act for comprehensive health service plans which would require, among other things, that any plan incorporated under the act be controlled by a board composed of one-third hospital trustees, one-third doctors, and one-third lay representatives of the public. In the course of the discussions, Mr. Louis H. Pink, president of Associated Hospital Service of New York City, urged expansion of Blue Cross to include the costs of medical care without delay.

In Philadelphia, where the medical society several years ago fought a bitter and unsuccessful battle to exclude radiology and pathology from the hospital service plan, a proposal has very recently been submitted to add complete medical care to Blue Cross benefits. The proponents candidly recommend repeal of the present Pennsylvania enabling act, which requires that a majority of the directors of medical service corporations be doctors of medicine.

Now I desire that I not be misunderstood. Coöperation between hospital service plans and medical or surgical service plans is essential. It is rather generally agreed among hospital leaders that Blue Cross enrollment has about reached its maximum unless contracts for hospital service can be coupled with insurance against medical costs. There is no doubt that the United States Public Health Service will emphasize this fact in the report of a study it is currently making of the movement. Furthermore, it is both logical and economical to delegate responsibility for sale and routine administration of the medical service plan to existing Blue Cross plans which have several years of experience and have acquired trained personnel. But, medical societies which turn over complete control of prepaid medical care to Blue Cross plans that are controlled by hospitals are traveling a dangerous road. They are violating one of the basic principles of organized medicine if they fail to establish a separate corporation to control the medical plan, with a board of directors of which at least a majority are doctors.

Ten years ago the American Medical Association laid down the postulate that: "All features of medical service in any method of medical practice should be under the control of the medical profession. No other body or individual is legally or educationally equipped to exercise such control." This principle has lost none of its validity.

If anyone is inclined to minimize the importance of this principle, he has but to follow the course of the controversy that has persisted between hospital service plans and the organized medical profession over the inclusion of certain medical services as a part of hospital care. For ten long years, county, state, and national medical organizations have insistently demanded that radiology and pathology be excluded from Blue Cross benefits. Everyone knows that the reaction of hospitals to these unequivocal demands has been one of polite indifference. What makes anyone think they

would follow the dictates of the medical profession concerning other branches of medicine, once they were in control of medical service plans?

Constantly during recent years the American College of Radiology has warned that medicine would sacrifice a basic principle if it yielded to the adamant demand of hospitals that they be permitted to include radiology and pathology in Blue Cross benefits as a part of hospital care. Too often our admonition that this would open the door to further encroachments by which hospitals would assume added prerogatives in the delivery of medical services, has fallen on unheeding ears. Now, as one medical editor has sardonically remarked, "The beans are on the carpet, spread out for all to see."

The second fact stated above, that Blue Cross plans would be integrated in a system of compulsory insurance, is likewise more than a mere assumption. Witness the curious tergiversation that has taken place in Rhode Island. Not long ago the governor of Rhode Island proposed a law for compulsory hospitalization insurance in his state. Promptly Blue Cross executives all over the country assailed the proposal as "un-American" and "regimentation." But, when the governor publicly announced that he contemplated the use of Blue Cross as an agency under the system, opposition quietly died.

The Wagner-Murray-Dingell bill, as you know, authorizes the Surgeon General to "negotiate agreements . . . with private agencies or institutions . . . to utilize their services and facilities. . . ." In response to a question from hospital spokesmen, Surgeon General Parran has already expressed the view that this would include Blue Cross plans.

I would point out that this provision in the bill would also permit medical service plans operated by medical societies to enter into contracts for rendering services to beneficiaries. Significant, also, is the provision in the Wagner bill which permits the practitioners in each area to elect the method by which payment shall be made for services. Does this not offer sufficient reason for medical societies to set up their own plans for prepaid medical care?

Unfortunately for radiologists, all the current problems confronting the private practice of medicine are egregiously manifest in the case of radiology. The threat of compulsory health insurance offers no exception. The future progress and advancement of the science of radiology may very well be determined by the status this specialty is accorded in voluntary plans for prepayment. Thus, the long unhappy fight of the American College of Radiology against the inclusion of medical services as a part of hospital care in group hospitalization assumes added significance.

It is encouraging to note that considerable progress has been made in solving this controversy. In Washington and Iowa, for instance, Blue Cross has agreed to separate radiology from hospital care and to pay cash benefits to the physician for x-ray services. The next step is to transfer these medical benefits from the hospital service plan to the medical service plan, where they belong. This has already been agreed to in New York, where, incidentally, the battle between radiologists and the hospital service plan has been hottest. Last year the Hospital Association of New York State approved a resolution providing that, "in those counties or areas where a Blue Shield Medical Care Plan exists, all prepaid medical and surgical care provided for under any prepaid plan and given through the hospitals or outside of the hospitals should be covered under the Blue Shield Medical Care Plan." The hospital association agreed that when medical service plans were established in areas where they do not now exist, the Blue Cross plan in the community would drop radiology, pathology, anesthesiology, and physiotherapy from its benefits and allow these services to be covered like other medical specialties in the medical service plan. We should offer our commendation to the New York Hospital Association for this splendid step toward solution of a controversy that has unfortunately caused ill

feeling on all sides and has undoubtedly retarded the growth of the Blue Cross movement.

Now, then, we have added incentive to continue our endeavors to place radiology on an equal footing with other medical specialties in all plans for prepaid health service. In voluntary plans, the services of a radiologist should be provided like other consultant's services among medical benefits. They should never be included in the per diem paid to hospitals for hospital care. Furthermore, with due respect for the many excellent features of the Blue Cross movement, I think we have every reason to raise our voice in opposition to those who would allow the hospital service plans to adopt the role of England's Friendly Societies by assuming control of medical care plans. There is a place for both, operating in close coöperation but each autonomous in its own field.

Although some of the proposals for compulsory health insurance submitted to Congress in recent years have included radiology among the services to be furnished by hospitals for a specified per diem, the Wagner-Murray-Dingell bill provides for separate payment to radiologists. It would be unfortunate if Blue Cross were to establish a different precedent. I believe we are justified in doubting that Blue Cross plans would separate radiology from hospital care if they were permitted to extend their benefits to cover medical or surgical services.

I have attempted here to present a point of view which I think carries profound consideration for American medicine, and especially for radiology. I have not said that voluntary plans of sickness insurance will be superseded by a compulsory system. I honestly do not believe they will be. But, as my friend A. M. Simons has wisely said, social experiments invariably establish patterns of precedent that are seldom completely reversed. In these dynamic times we have extra reason to be vigilant and to exercise sound judgment in our decisions.

Fortunately for the radiologists of America an instrument for maintaining vigilance and directing policies on the basis of sound interpretation exists through the American College of Radiology. It provides what former president W. Edward Chamberlain has referred to as "fire-fighting machinery." Even if the fires cannot always be extinguished, the program of the College keeps them under control and helps to guide the course of future events in a direction least harmful to accepted principles of good radiologic practice.

The magazine, *Medical Economics*, in a recent article, referred with approval to the agressive program of the College and observed that it was leading the spearhead of medicine's fight against the tendency for third-party agencies to assume the role of distributing agencies for medical services. Said *Medical Economics:* "While the other clinical specialists have a large stake in any such dispute, the radiologists are taking the lead through their vigorous organization, the American College of Radiology."

The reports of the various Commissions and Committees of the Board of Chancellors to be presented at this meeting offer good evidence of the fact that the College is alert, informed, and active, and that it has a positive program for the preservation of essential principles. This program, of course, is not confined solely to socio-economics. The broad scope of the College program in education, hospital standards, and other activities of the organization are directed toward a single objective: the advancement of the science of radiology and the promotion of its contributions to human welfare.

I am constrained to say again, as I have before, that the Members and Fellows of the American College of Radiology should be grateful to their appointed leaders, who direct the affairs of the College, for the unselfish effort these individuals are devoting to a cause which they approach with the deepest sincerity.

MAC F. CAHAL
Executive Secretary
American College of Radiology

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL ASSOCIATION

At a recent meeting of the Radiological Section of the Los Angeles County (California) Medical Association, the following were elected officers for the current year: Donald R. Laing, M.D., President; Herbert A. Judson, M.D., Vice-President; Roy W. Johnson, M.D., Secretary; Henry Snure, M.D., Treasurer.

SOCIEDAD PERUANA DE RADIOLOGIA

The Radiological Society of Peru, founded in November 1938, announces the following list of officers for the present year: President, Dr. Enrique Gonzáles Vera; Vice-President, Dr. Lorenzo Horna Gil; Secretary, Dr. Victor Giannoni; Pro-Secretary, Dr. Julio Bedoya Paredes; Treasurer, Dr. Santiago Sánchez Checa; Librarian, Dr. Francisco Guerrero Burga.

In Memoriam

JOHN MILTON HILL

1898–1944

Dr. John Milton Hill died on Nov. 13, 1944, in the Walter Reed Hospital, following an operation for a brain tumor. Doctor Hill was graduated from the University of Pittsburgh School of Medicine in 1932. He served on the staff of the Passavant, St. John's General, Presbyterian, and Woman's Hospital, Pittsburgh, and was assistant radiologist at the Falk Clinic. He was commissioned a major in the medical reserve corps of the U. S. Army in 1942, was subsequently promoted to lieutenant colonel, and served in Australia. Doctor Hill was a diplomate of the American Board of Radiology and a member of the American College of Radiology and the Radiological Society of North America.

HARLAN PAGE MILLS, M.D.

1873–1945

Dr. Harlan Page Mills, of Phoenix, Ariz., for many years Counsellor of the Radiological Society of North America for Arizona, died at the age of seventy-two on Feb. 27, 1945.

Doctor Mills was born in Isadora, Mo., received his medical degree from the Marion Sims-Beaumont Medical College, known later as the St. Louis University School of Medicine, and spent some years in general practice in that state. In 1914 he joined the staff of the Arizona State Hospital at Phoenix. In 1917 he was induced to become associated with the Pathological Laboratory, then a young and struggling venture in the medical life of the state. His work in that organization and in St. Joseph Hospital and the Good Samaritan Hospital, Phoenix, occupied the remainder of his professional life. He served as head of the department of pathology and later as consulting pathologist in each of these hospitals. While Doctor Mills' primary interest was in pathology, he was almost equally well known as a radiologist. Among his contributions to the literature are a number, in collaboration with Dr. Wm. W. Watkins, appearing in RADIOLOGY. He was a member of the Southwestern Medical Association, a Fellow of the American College of Physicians, and a diplomate of the American Board of Pathology.

FRANK C. NEAL, M.D.

1879–1945

Dr. Frank C. Neal, of Peterborough, Ontario, died suddenly on Jan. 18, 1945, while examining a patient. Doctor Neal was a graduate of Toronto University and studied also in England. He had been in practice in Peterborough for forty years. He was a Fellow of the American College of Physicians and a member of the Radiological Society of North America.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

MASS RADIOGRAPHY OF THE CHEST. By HERMAN E. HILLEBOE, M.D., Medical Director, Chief, Tuberculosis Control Division, U. S. Public Health Service; Professorial Lecturer on Tuberculosis Control, George Washington University School of Medicine, Washington, D. C., and RUSSELL H. MORGAN, M.D., Surgeon (R), Medical Officer-in-Charge, Radiology Section, Tuberculosis Control Division, U. S. Public Health Service; Assistant Professor of Roentgenology (absent on leave), The University of Chicago. A volume of 288 pages, with 93 illustrations. Published by the Year Book Publishers, Inc., Chicago, Ill. Price $3.50.

RADIOLOGIC EXAMINATION OF THE SMALL INTESTINE. By ROSS GOLDEN, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Director of the Radiological Service, The Presbyterian Hospital, New York. A volume of 239 pages, with illustrations of 183 subjects in 75 figures. Published by J. B. Lippincott Co., Philadelphia. Price $6.00.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago 11, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Carlton L. Ould, University Hospital, Medical Center, San Francisco 22. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Secretary, Arthur W. Erskine, M.D., Suite 326 Higley Building, Iowa City. Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, 101 W. Chestnut St., Louisville.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at offices of members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

St. Louis Society of Radiologists.—Secretary, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary-Treasurer, Donald H. Breit, M.D., University of Nebraska Hospital, Omaha 5. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary-Treasurer,* George Levene, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

Rochester Roentgen-ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary. L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22d St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Dallas-Fort Worth Roentgen Study Club.—Secretary, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth, Texas. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

Texas Radiological Society.—Secretary-Treasurer, Asa E. Seeds, Baylor Hospital, Dallas.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiologia y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Peritoneum

The Spleen

The Skeletal System

Gynecology and Obstetrics

The Genito-Urinary Tract

The Blood Vessels

Foreign Bodies

RADIOTHERAPY

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Stereoscopic versus Plain Films in Accessory Sinus Examinations. Frederick M. Law. Ann. Otol., Rhin. & Laryng. **53:** 531–535, September 1944.

For roentgenography of the accessory nasal sinuses, stereoscopic films are generally most satisfactory. They are particularly indicated under the following conditions:

(1) Fractures of the skull.

(2) Fractures of the nasal bones. Here they enable one to see which side is fractured and how much displacement exists.

(3) Where a film taken in the Waters position shows an apparent tumor in the antrum. The stereoscopic view may show the suspected tumor to be merely the image of the cheek or upper lip superimposed on the antrum.

(4) Where the film taken in the Waters position is negative while one taken in the 23°-angle position is positive. The stereoscopic film may show the opacity in the latter view to be due to an increased density of the floor of the posterior cranial fossa.

(5) Where it is difficult to determine whether the right or left ethmoid shows a change in the appearance of the cell structure as viewed on the lateral film.

(6) Where it is difficult to determine on which side a large agger cell exists.

(7 and 8) Where an enlargement of the sella turcica or bony involvement of the skull is present.

(9) When absence or four-plus involvement of a frontal sinus is suggested by a faint circular line of density where the superior border of the frontal sinus should be. A stereoscopic film may show this line to be part of the occipital suture superimposed on the frontal region, and not the superior border of the frontal sinus, thus proving the absence of the latter.

(10) Where the lateral film shows an apparent partition dividing the antrum into two sections. A stereoscopic film will show this apparent partition to be the posterior border of the malar bone.

(11 and 12) For examination of the petrous pyramid and for salivary calculus.

(13) Where an apparent soft-tissue tumor is shown on lateral films of the pharynx. A stereoscopic film may identify this as the lobe of the ear.

(14) In the presence of a malignant neoplasm involving the antra. The stereoscopic view reveals more accurately the degree of bony involvement.

STEPHEN N. TAGER, M.D.

An Otolaryngologic Aspect of Frontal Meningocele. Report of Cases. E. A. Stuart. Arch. Otolaryng. **40:** 171–174, September 1944.

Frontal meningocele is rarely encountered, but it must be considered in the differential diagnosis of various fronto-orbital conditions. It is usually congenital in origin and therefore precedes any development of the frontal sinuses. It may, however, be the result of trauma, as in one of the four cases presented here. For this reason, it is impossible to rule out a diagnosis of frontal meningocele simply because the lesion has appeared after birth.

In each of the cases in this series treatment was sought during the first year of life. A patient with a small meningocele who did not seek medical advice until adolescence or adult life would present a greater diagnostic problem.

Roentgenograms in the case of a boy of eleven months are reproduced. They show a frontal meningocele associated with separation of the orbits and defective development of the cribriform plate and portions of the superior orbital plates.

Oral Aspect of Cleidocranial Dysostosis. William S. Britt. Mil. Surgeon **95:** 143–147, August 1944.

The author discusses the salient features of cleidocranial dysostosis, with special emphasis on the oral aspect, and reports a case. These patients are generally small. The head is large and brachycephalic, with sutures and fontanelles showing delayed closure; there is characteristic bossing of the frontal, parietal, and occipital bones, with prominent median groove or furrow. One or both clavicles may be absent. The jaws are slightly undersized, the maxilla being micrognathous and the mandible prognathous. The maxilla is narrow and shows lack of development, with a high palate and overcrowding of the teeth. The most outstanding dental anomaly is the extreme delay in dentition and eruption of the teeth. X-ray examination in most cases shows a large percentage of the permanent teeth unerupted. Teeth not having predecessors, such as the first and second molars, are often seen in normal erupted positions. Extensive caries, periodontoclasia, and gingivitis are common because of the abnormal occlusion of the teeth and consequent lack of natural exercise of teeth and gums.

THE CHEST

Mass Chest Roentgenography and Admissions to Olive View Sanatorium. Joseph Goorwitch. Am. Rev. Tuberc. **50:** 214–222, September 1944.

For the purposes of this study, the literature on mass roentgenography of the chest was reviewed, including data on more than 800,000 examinations. The consensus of opinion among those who have had experience with such a procedure is that minimal and often more advanced stages of pulmonary tuberculosis, among other abnormalities, can be discovered only by roentgenography.

The effect of routine induction and isolated preemployment chest roentgenography in the county of Los Angeles on the admissions to Olive View Sanatorium is analyzed. It was found that such mass examinations have led to both a relative and an absolute increase in the number of males admitted, reversing the pre-war ratio of males to females. There was, however, no change in incidence of far advanced disease among all males admitted, in spite of the fact that in 23 per cent of them the disease had been discovered during routine surveys. Several explanations are offered: Pulmonary tuberculosis, when first diagnosed, is more advanced in males than in females, according to reports in the literature. The extent of involvement in cases discovered in mass surveys was decidedly less than among males admitted following diagnosis by non-survey methods. Those with advanced disease are more likely to seek and gain admission to a sanatorium.

L. W. PAUL, M.D.

Case Finding by Mass Radiography. A Report on 500 Selected Cases. Alexander Kahan and H. G. Close. Lancet **1:** 653–654, May 20, 1944.

A careful investigation was made of 500 patients from a naval depot after a large film had confirmed an abnormality seen in the miniature film. The patient was kept in bed for five days, during which time clinical examination was carried out, a four-hourly chart kept, sputa and gastric contents were examined for tubercle bacilli, intradermal tuberculin tests were done, the erythrocyte sedimentation rate was estimated, the weight recorded and, if necessary, another chest roentgenogram was taken. The case was then reviewed and placed in one of the groups described below or the patient was referred for continued observation in the hospital or as an outpatient. None of these patients had reported sick. Any symptoms were minimal and had been regarded as insignificant. Often the examiners were unable to detect any abnormal physical signs in cases showing gross roentgenologic changes, from which it is concluded that physical signs in the chest are relatively unimportant.

The 500 cases were distributed among the following groups: Group 1, fit for duty, 134 men; Group 2, recommended three months' observation on shore duties, 143 men; Group 3, active tuberculosis, bacteriologically positive, 69 men; Group 4, active tuberculosis, bacteriologically negative, 69 men; Group 5, lesions of tuberculous origin with no evidence of activity but likely to break down under service conditions, 29 men; Group 6, non-tuberculous "pneumonitis," 22 men; Group 7, unfit for service on account of other diseases, 34 men. Group 2 consisted largely of men over 25 years of age with doubtful roentgen changes but with no other evidence of active disease. Group 5 was made up mainly of young men, from 18 to 22, with small round or oval opacities usually in the upper zone with no other evidence of active disease.

These 500 cases form a part of a series of 44,000 previously analyzed by Brooks (Proc. Roy. Soc. Med. **36:** 155, 1943. Abst. in Radiology **41:** 600, 1943).

Management of Minimal Pulmonary Tuberculosis Disclosed by Fluorography. W. D. W. Brooks. Lancet **1:** 745–748, June 10, 1944.

Fluorography of 479,373, apparently healthy male personnel of the Royal Navy showed that 6,077 (12.7 per 1,000) had radiological signs of adult-type pulmonary tuberculosis. In 47.9 per cent of these the lesion was "minimal." By minimal tuberculosis the authors mean adult (reinfection) type pulmonary tuberculosis which, as shown roentgenologically, consists of infiltration without demonstrable cavitation affecting a volume of lung (regardless of distribution) which does not exceed that volume of lung tissue lying above the second chondrosternal junction and the body of the fifth thoracic vertebra on one side. In some of the minimal cases the disease is arrested or is retrogressive, but in others it is progressive. Of the 2,911 sailors with minimal lesions who were studied in the hospital, 16 per cent showed evidence of active infection; in 63 per cent, the disease appeared to be inactive, but the stability of the lesions was doubtful; in 21 per cent the lesion was inactive.

Of 23,344 WRNS, 213 (9.1 per 1,000) had roentgen evidence of tuberculosis, and the lesion was minimal in 55.4 per cent. In 18 per cent, the lesion was considered active.

Naval personnel with apparently inactive minimal tuberculosis were placed on light shore duties and kept under observation. Study of these cases shows that the younger the patient the more likely is the disease to become active and the relapse to be serious. The findings indicate that a diagnosis of apparently inactive minimal tuberculosis in males under fifty should imply outpatient supervision, with regular inpatient re-examination during the next two years. For patients under thirty, this observation period should probably be longer.

Similar investigations among civilians will no doubt bring to light a large number of cases of pulmonary tuberculosis of slight degree, raising difficult problems of disposal and treatment.

Cavernous Breathing: Is There Such a Sound? George G. Ornstein. Dis. of Chest **10:** 407–414, September–October 1944.

Cavernous breathing, so-called, was originally described by Austin Flint as an inspiratory blowing sound, low in pitch and non-vesicular in quality, with an expiratory sound of lower pitch of the same quality, and of variable length and intensity. The author does not believe that such sounds are produced by a cavity and is of the opinion that Flint mistook exaggerated vesicular breathing, which is frequently found in the vicinity of tuberculous infiltration, for evidence of cavity formation. In support of his view, the author presents a series of roentgenograms, made by the tomographic technic, with observations on the nature of the breath sounds in the cases illustrated. He concludes that the most common finding over a cavity is diminished broncho-vesicular breathing often accompanied by high-pitched moist râles. Thin-walled check-valve cavities are frequently silent. Uninvolved lung tissue overlying a cavity may produce vesicular breath sounds. A cavity in an old atelectatic lobe may transmit tracheal or bronchial sounds—frequently but erroneously called broncho-cavernous breathing. HENRY K. TAYLOR, M.D.

Lobar, Broncho-, and Atypical Pneumonia; A Study of Five Hundred Cases. Albert W. Hobby. U. S. Nav. M. Bull. **43:** 438–449, September 1944.

The author analyzes 500 cases of pneumonia seen at a U. S. Naval Hospital from Oct. 1, 1941, to Jan. 1, 1944. They are grouped as lobar pneumonia, 112 cases; bronchopneumonia, 62 cases; atypical pneumonia, 326 cases. Monthly distribution charts reveal a striking increase in the incidence of the atypical form.

The usual x-ray findings in lobar and bronchopneumonia are described. The x-ray findings in the atypical pneumonias, among which the author includes the influenzal pneumonias, vary greatly. A confluent mottling, usually of homogeneous density, in the central portion with the borders fading into normal lung tissue, was found to occur anywhere in the lung, and not just at the hilus with extension into the parenchyma, as described elsewhere in the literature. In this group of cases, the pneumonic process usually occurred in the lower half of the lung.

The author believes that atypical pneumonia should be considered as a phase of an upper respiratory infection which has gravitated to the lungs. He would divide the syndrome into a bronchitic, a peribronchitic,

an alveolar, and a broncho-alveolar phase. Any phase may exist independently or coincidental with the other phases.

The usual therapy was employed, with success, in all types of pneumonia. In addition, x-ray therapy was found of value in the atypical cases. It not only afforded subjective relief but also reduced the number of hospital days by as much as one-fourth in some cases. STANLEY H. MACHT, M.D.

Pneumonitis Associated with Malaria. I. L. Applebaum and Joel Shrager. Arch. Int. Med. **74:** 155–162, September 1944.

One hundred and twenty-five consecutive patients with pneumonitis associated with malaria admitted to Gorgas Hospital from January 1942 through May 1943 were studied. Most of these patients (70 per cent) were young white men attached to the military personnel. The incidence of pneumonitis in persons with malaria in the military group was 3.7 per cent. The occurrence was greatest during the rainy season, when both malaria and primary pneumonitis were most frequently encountered as separate entities. Acute and gradual onset of symptoms occurred with equal frequency. Symptoms in the upper respiratory tract preceded constitutional manifestations in 20 per cent of the cases. The chief complaints in order of frequency were: fever, cough, chills, headache, expectoration, malaise, general aches, gastro-intestinal symptoms, pain in the chest, disturbances in the upper respiratory tract, and excessive sweats. The chief physical findings were râles, bronchovesicular breath sounds, and dullness. There was an absence of objective signs in 36 per cent of the cases, attesting to the importance of roentgen examination. Positive findings referable to malaria were not prominent.

In 121 of 125 cases, or 97.8 per cent, roentgen examination was utilized for diagnostic purposes. The lesions were mainly of lower lobe distribution and of the lobular type. There were no serious complications.

Cases of estivo-autumnal and of tertian malaria associated with pneumonitis were about equal in number. There was no significant difference between the two groups in the clinical course or response to therapy.

Many of the patients with pneumonitis exhibited adequate response to antimalarial therapy; a fair proportion reacted favorably to sulfonamide compounds, and in a number the disease ran its course unaffected by treatment. On the basis of this study, pneumonitis in malaria is classified as follows: (1) atypical or virus pneumonitis with inadequate response to the therapy employed, running a self-limited course; (2) bacterial pneumonitis, with adequate response to sulfonamides; (3) malarial pneumonitis, with favorable response to antimalarial drugs.

Bronchial Obstructions in Primary Pulmonary Tuberculosis. W. F. Richards. Proc. Roy. Soc. Med. **37:** 589–592, August 1944.

Of 239 children under six years of age suffering from primary tuberculosis of the lungs, 50 (21 per cent) experienced a sector or lobar collapse due to bronchial obstruction. Above this age, the incidence of the complication was less—7 per cent of 114 children whose ages ranged from six to nine years, and 6.5 per cent of 92 children over ten.

In this series the right middle bronchus was involved 23 times out of a total of 66 affected lobes. Next came involvement of the right lower lobe or right basal bronchi, 13 times. The right and left upper lobes were equally involved, with 9 collapses each, and the left middle lobe or lingula and left base were affected in 6 cases each. In 4 children more than one lobe was involved. In 32 of the 64 cases, re-expansion occurred without incident. The shortest time from collapse to spontaneous re-expansion was one month; the longest, while under observation, was two years. In 10 of the 64 patients, or 15.6 per cent, bronchiectasis developed. Twenty-two, or 34.4 per cent, still had their collapse on discharge. ELLWOOD W. GODFREY, M.D.

Obstructive Emphysema in Infancy Due to Tuberculous Mediastinal Glands. Report of a Case. L. G. Pray. J. Pediat. **25:** 253–256, September 1944.

A case of obstructive emphysema of the left lung in a 4 1/2-month-old infant is presented. The child was seen three or four days after the onset of the illness, which began with difficulty in breathing. Respirations were extremely labored and rapid, with supraclavicular bulging on expiration and deep retraction on inspiration. The percussion note was resonant throughout and somewhat hyperresonant over the left chest. The breath sounds were short, more so on the left than on the right. X-ray examination of the chest showed an obstructive emphysema of the left lung, with secondary inflammatory changes in the perihilar region. The mediastinum was shifted to the right, and there was compression of the right upper lung field. There was no opaque foreign body or obstructing lesion of the left main bronchus, but on bronchoscopy changes due to external compression were demonstrated. A tracheotomy produced temporary relief, but the child died the second day after hospital admission. Autopsy showed the compression of the bronchus to be due to tuberculous tracheobronchial lymph nodes.

Bronchiolitis in Children. G. H. Newns. Proc. Roy. Soc. Med. **37:** 580–585, August 1944.

Acute bronchiolitis has been previously described under the designations capillary bronchitis and interstitial bronchopneumonia. While it is not a common disease, the incidence rises sharply in epidemics of influenza; it may also accompany measles or pertussis, or arise independently of these diseases. An important etiologic factor is the predisposing influence of a virus infection which makes possible the invasion of bacteria and enormously intensifies their effects.

Pathologically bronchiolitis is divided into the catarrhal and mural types. In the catarrhal type the mucous membrane alone is involved, while the wall is unaffected. The mural type is further divided into simple, proliferative, and destructive phases. The incidence and severity are greatest in childhood. The typical onset is that of a mild tracheobronchitis, soon succeeded by more severe symptoms, consisting of rapid respiration, high fever, obstructive dyspnea, cyanosis, prostration, and collapse. The greatest difficulty seems to be in getting air into the lungs. The disease may be confused with bronchopneumonia; but here the x-ray is helpful, as gradations from nothing definitely abnormal to a diffuse, fine mottling, often very faint, but occasionally so marked as to simulate miliary tuberculosis, are seen on the film. ELLWOOD W. GODFREY, M.D.

Eosinophilic Infiltration of the Lungs (Loeffler's Syndrome). Stewart H. Jones and Carlton R. Souders. New England J. Med. **231:** 356–358, Sept. 7, 1944.

The exact pathological nature of the syndrome first described by Löffler in 1932 is unknown, since no deaths have been reported. The cause also is undetermined but is believed to be in the nature of an allergy, since the condition is associated with vasomotor rhinitis and asthma. It has been found in association with parasitic infections and brucellosis.

The patient complains of a metallic taste, cough, wheezing, and malaise. There is a slight fever, and diminished resonance and sibilant râles are elicited over the area of pulmonary consolidation. Blood examination shows a leukocytosis, eosinophilia of 10 to 60 per cent, and increased sedimentation rate.

Roentgenographically the pulmonary infiltrations are indistinguishable from pulmonary tuberculosis, with clear and irregular outlines. The shadows appear rapidly, disappear in three to eight days, only to appear elsewhere in the lungs. The lesion may be single, multiple, unilateral, or bilateral.

This condition may be mistaken for tuberculosis, bronchiectasis, neoplasm, or so-called abortive pneumonia. JOHN B. MCANENY, M.D.

Transitory Migratory Pulmonary Infiltrations Associated with Eosinophilia (Loeffler's Syndrome), with the Report of an Additional Case. J. Winthrop Peabody. Dis. of Chest **10:** 391–406, September–October 1944.

Löffler's syndrome is a transitory migratory pulmonary infiltration demonstrable on serial roentgenographic examinations, associated with an eosinophilia. The clinical course is mild and symptoms may be minimal. On physical examination there may be no findings, or a few moist and sibilant râles over the areas of consolidation. Roentgen examination shows small or large areas of consolidation which appear and disappear suddenly in various parts of the lungs, most often in the lower fields. The roentgen findings may simulate the adult type of pulmonary tuberculosis. The eosinophilia is sometimes accompanied by a moderately high leukocytosis and a slightly elevated sedimentation rate. There is no parallelism between the degree of eosinophilia and the extent of pulmonary involvement.

The pathogenesis is undetermined; it is thought to be on an allergic basis. The etiologic agent or agents have not been identified, but intestinal parasitism may be a factor.

A case is reported with a high degree of eosinophilia and pulmonary infiltration which variously involved one lung and both lungs, varying as to location, and disappearing completely at intervals.

HENRY K. TAYLOR, M.D.

Cystic Disease of the Lung with Iodized Oil Studies. H. Vernon Madsen and H. B. Pirkle. Dis. of Chest **10:** 433–441, September–October 1944.

The authors review the literature on cystic disease of the lung. There is no general agreement as to whether the condition is congenital or acquired. Peirce (Am J. Roentgenol. **44:** 848, 1940) believes that most cases are acquired. Two anatomical types are recognized: (1) bronchial dilatations, with muscle tissue and cartilage in the walls, and (2) subpleural cavities resembling emphysematous blebs. The cysts may be single or multiple, unilocular or multilocular, small or large, oval or spherical, and may contain fluid or air, or both. The adjacent alveoli may be atelectatic or may have failed to develop. Symptoms include dyspnea, cyanosis, cough, palpitation and, rarely, hemoptysis.

The roentgen appearance varies, being dependent upon the location, size, number, and content of the cysts and the absence or presence of concurrent disease. Fluid-filled cysts may resemble neoplasms, hydatid or dermoid cysts, or aneurysm. Even after careful study, it may be necessary to make a non-specific diagnosis of tumor of the lung. An infected fluid-filled cyst surrounded by an irregular zone of reactive inflammation resembles and in most cases will be mistaken for an abscess or pneumonic consolidation. Cysts containing both air and fluid must be differentiated from abscess, tuberculous cavitation, and draining hydatid cyst. Large air-filled cysts can be distinguished roentgenologically with a high degree of accuracy. They usually are single or do not exceed two or three in number. There is a radioparent area devoid of normal pulmonary markings, and the part of the wall of the cyst in contact with the lung appears as a regularly curved line or lines. For cases offering difficulty in diagnosis a number of special procedures are suggested. In the authors' case an artificial pneumothorax was established and 10 c.c. of iodized oil were injected into the pleural space. The patient was then placed in the horizontal position, with the head lower than the feet, and was rolled forward and backward (being observed at the same time under the fluoroscope) to distribute the iodized oil over the surface of the pleura. Roentgenograms made immediately following this procedure clearly demonstrated the cystic spaces.

Treatment is in general unsatisfactory. In the authors' case it had not been attempted.

HENRY K. TAYLOR, M.D.

Broncholithiasis. Walter S. Anderson and J. B. Mackay. Dis. of Chest **10:** 427–432, September–October 1944.

Broncholithiasis is of rare occurrence. The stones may be endobronchial in origin but more often enter the bronchus from without, following erosion of the wall. Most frequently they represent the end stage of a primary tuberculous lesion in the tracheobronchial lymph nodes, though they may result from other types of pulmonary inflammation or suppuration. In most of the reported cases the diagnosis was made following expectoration of the stones. Roentgen examination discloses evidence of either partial or complete obstruction of a bronchus, but bronchoscopy is required for differentiation from bronchiogenic carcinoma. In the author's case, however, swelling proximal to the obstruction, involving the curve of the bronchus, prevented bronchoscopic visualization of the lesion and showed only normal mucosa. The patient was a woman of 33 with a history of cough and recurrent hemoptyses. Roentgenography following lipiodol injection showed an obstruction of the right middle bronchus. This was interpreted as bronchiogenic carcinoma. Lobectomy was performed and 3 broncholiths lying in an ulcerated area were found. These concretions originated in a calcified lymph node which had perforated the bronchus, eroding a blood vessel in the process. HENRY K. TAYLOR, M.D.

Pneumoconiosis in Boiler-Scalers. P. G. Todd and David Rice. Lancet **1:** 309, March 4, 1944.

An additional case of pneumoconiosis in a boiler-scaler is reported. Roentgen examination showed a "snow-storm" type of infiltration of both lungs equal in intensity from hilum to periphery, suggesting either miliary tuberculosis or pneumoconiosis. No tubercle bacilli were found in the sputum.

Cadmium Poisoning in Industry: Report of Five Cases, Including One Death. Louis W. Spolyar, J. F. Keppler, and Herman G. Porter. J. Indust. Hyg. & Toxicol. **26:** 232–240, September 1944.

Five cases of cadmium poisoning in industry, with one death, are reported. Cadmium poisoning, by way of the respiratory route, produces few immediate symptoms. Within four to eight hours patients complain of irritation of the throat, headaches, and cough. Some twenty to thirty-six hours after exposure symptoms develop suggesting pulmonary edema—dyspnea, pain in chest, and persistent cough. Among the 59 reported cases in the literature, there were 9 deaths, a mortality of 15 per cent. Death was found to occur from the fifth to seventh day after exposure. Recovery ensues within a period of seven to eleven days after exposure. X-ray examination of three of the cases reported here, four weeks after exposure, showed the men to be free of residual chest lesions.

Pulmonary Changes in Chronic Cystic Pancreatic Disease. George J. Baylin. Am. J. Roentgenol. **52:** 303–306, September 1944.

Andersen (J. Pediat. **15:** 763, 1939, and Am. J. Dis. Child. **56:** 344, 1938) described certain striking changes seen in a number of infants who succumbed to pulmonary infections. She found that the pancreas was small and irregular and that microscopically it was composed of small and large cysts lined with epithelium. The ducts were usually embedded in masses of fibrous tissue. The lungs in all cases showed bronchitis and bronchopneumonia; bronchiectasis and atelectasis were frequently observed.

This condition, now recognized as a clinical entity, is observed for the most part in infants dying from bronchopneumonia or other pulmonary lesions before the age of six months. A smaller group survive for longer periods, up to fourteen years, presenting the so-called celiac syndrome. In another small group—about 10 per cent of the total—death occurs in the first two weeks of life.

The underlying disease process is apt to go unrecognized. The hilar regions of the lungs show marked involvement characterized roentgenologically by areas of increased mottled density. Toward the periphery there are streaking and mottling which is much less pronounced. Evidences of atelectasis and bronchiectasis may also be observed. The roentgen picture is so consistent that, even though it cannot be considered absolutely diagnostic, it should invariably arouse suspicion of fibrocystic pancreatitis. Secondary changes in the physiology of the intestinal tract—hypomotility associated with some dilatation of the small intestine—may be demonstrable on a plain film or in barium studies.

The relationship between the pancreatic and pulmonary lesions is obscure. Deficiency in fat absorption and metabolism may lead to vitamin-A deficiency, which results in serious epithelial changes in the lungs. It is also possible that a coexisting congenital abnormality of the pancreas and lungs exists. The prognosis is poor. There are some instances on record in which intensive supportive and vitamin therapy resulted in at least temporary clinical improvement.

CLARENCE E. WEAVER, M.D.

Blastomycosis of the Skin (Gilchrist Type) with Associated Blastomycetic Pulmonary Disease. Report of a Case. Arthur Sayer. U. S. Nav. M. Bull. **43:** 333–342, August 1944.

Cutaneous blastomycosis is not a common disease in this country. It may be accompanied by or be a part of generalized blastomycosis. It is a chronic inflammatory disease of the skin producing sharply elevated verrucose patches of varying size with a characteristic sloping border in which are the blastomyces. The lesions occur most frequently on the face, wrist, and forearm. When the disease becomes generalized, the lungs, liver, kidneys, spleen, and bones may be involved. The mortality in systemic cases is reported at 90 per cent.

Sayer presents a case which exhibits most of the characteristic changes of cutaneous blastomycosis. The disease was originally diagnosed in 1939 and, when first seen by the author, had been present over four years. The patient had extensive lesions on the right side of the face and neck, involving also the eyelids, and a separate lesion of the left elbow. He had been on more or less continuous potassium iodide therapy for three years. He had also received x-ray therapy to the skin lesions; the exact dosage was not known but was apparently sufficient to have produced permanent skin damage, in the opinion of the author. For this reason no additional x-ray therapy was given, but the iodide therapy was increased until the patient was receiving as much as 420 grains of potassium iodide daily by mouth and 31.5 grains of sodium iodide intravenously. The oral dose was later increased to 480 grains per day and the injections were discontinued. There was definite improvement in the cutaneous lesions with this therapy.

Included in the article are reproductions of two chest roentgenograms from this case. The author states that a diagnosis of blastomycosis of the lungs was made on the roentgen findings. He also states that, after three months of the highly intensified iodide therapy, the chest film showed a marked improvement. [The reviewer believes that many of the changes present in these roentgenograms could be ascribed to apical pulmonary tuberculosis, which was one of the original diagnoses in this case before cutaneous blastomycosis developed.] In addition to the iodide treatment, the patient was given sulfadiazine and two million units of penicillin with no benefit. The iodide therapy was being continued at the time of the report, since it was the only treatment which had been efficacious.

BERNARD S. KALAYJIAN, M.D.

Posterior Mediastinal Goiter. J. M. Mora, H. J. Isaacs, S. H. Spencer, and L. Edidin. Surg., Gynec. & Obst. **79:** 314–317, September 1944.

The authors report a case of posterior mediastinal goiter, the seventh to be recorded. The patient was a 55-year-old white woman who had been studied for eight years by many physicians. All, on roentgen ex-

amination, had observed a large shadow occupying the right upper lung field. Basal metabolic determinations on a number of occasions had been reported normal. Roentgen examination by the authors showed a large globular mass in the posterior mediastinum. They found, also, the classic signs and symptoms of hyperthyroidism, with a basal metabolic rate varying between +45 and +51. A diagnosis of thyrotoxicosis was made, and the mass was believed to be a large intrathoracic goiter. On operation, this diagnosis proved correct, the goiter being of the adenomatous type. The patient made an uneventful recovery, and the basal metabolic rate one year later was +6.

The authors state that the descent of these thyroid masses is brought about by a number of factors, including breathing, swallowing; muscular activity in flexing and rotating the head, and gravity. Some patients are without symptoms; some exhibit evidence of thyrotoxicosis with or without pressure symptoms. Anteroposterior and lateral roentgenograms will substantiate the clinical diagnosis. Fluoroscopic observation of movement of the mass on deglutition is of particular significance. Treatment consists in surgical removal.

N. P. SALNER, M.D.

Angle of Clearance of the Left Ventricle as an Index to Cardiac Size: Modified Technic for Its Determination and Range of Values for Normal Children. Robert L. Jackson, Robert A. J. Einstein, Alice Blau, and Helen G. Kelly. Am. J. Dis. Child. **68:** 157–162, September 1944.

The authors describe a modification of the Wilson technic for the determination of the angle of clearance of the left ventricle, *i.e.*, the amount of rotation of the subject necessary to separate the left lower border of the cardiac silhouette (left ventricle) from the vertebral column, on fluoroscopic examination in the left anterior oblique position.

With the original Wilson technic, two major difficulties were encountered. First, it was found that the left border of the cardiac shadow clears the spinal column at two points: (1) the point of separation from the projection of the transverse processes of the spine; (2) the point of separation from the anterior border of the vertebral bodies. There was a difference of approximately 10° between these two angles of clearance. A second difficulty lay in minor changes in the position of the patient. To obviate errors caused by position or posture change, the authors used a stool with an adjustable foot-rest and back, constructed on a turntable, and examined the subject in a sitting rather than in the usual standing position. Both angles of clearance were measured.

Sixteen normal children received from eight to thirteen examinations each, three or four at one session. The mean value of the repeated measurements was assumed to be the true angle of clearance. Not over 10 per cent of the single measurements varied more than 5° from the true value. For 11 of the group, or 69 per cent, the mean deviation from the true value was less than 3.5° for both clearance angles.

Having thus determined the reliability of this method of study, the authors examined 102 normal children to ascertain the range of values in the absence of cardiac disease. In this group, the values for the first angle of clearance ranged from 38 to 67°, with a mean value of 51.8° and a standard deviation of 5.8°. The values for the second angle of clearance ranged from 46 to 86°, with a mean value of 63.2° and a standard deviation of 7.4°. Patients with vertically placed hearts showed a smaller angle of clearance than those with transversely placed hearts. Neither age nor sex showed any significant influence on the measurements.

The procedure should be valuable clinically for the determination of changes in the heart size during the course of rheumatic or other cardiac disease.

LESTER M. J. FREEDMAN, M.D.

Cor Biatriatum Triloculare. Case Report. Margaret M. Glendy, R. Earle Glendy, and Paul D. White. Am. Heart J. **28:** 395–401, September 1944.

The authors report an unusual case of absence of the ventricular septum in a boy seen by them at the age of 9 years. He had been known for two years to have heart disease, but had led an active life up to three weeks before his admission to the hospital with a terminal infection. The most notable feature in the case was the absence of any history of cyanosis except on swimming. Even terminally, cyanosis was of only slight degree.

Successive roentgenograms revealed a greatly enlarged heart and pulmonary congestion. The last one, made on the day before death, five weeks after admission, showed a further increase in the cardiac size, with a change in contour suggesting a pericardial effusion. A pericardial tap was attempted but only dark blood was obtained. The clinical diagnosis was acute and chronic rheumatic heart disease, with acute cardiac dilatation and failure.

Postmortem examination revealed a very large heart, with the ventricular wall measuring 22 mm. in thickness and a patent foramen ovale 1 cm. in diameter. There was a single large ventricular cavity with a small outpocketing representing the rudimentary left venticle or bulbus. From the large ventricular cavity the aorta arose at the anterior upper left margin, its base forming the bulb just mentioned. All the valves except the mitral appeared smooth and competent. The mitral valve was thickened along its free border, but no vegetations were present. The pulmonary artery was dilated and its diameter was several times that of the aorta. Just beyond the site of the subclavian artery there was slight to moderate coarctation of the aorta, which measured 8 mm. in diameter.

The authors believe that the absence of cyanosis in this case may be explained in part by the fact that the location of the aorta was such that the arterial blood returning *via* the mitral valve probably formed a barrier against too great admixture with venous blood returning *via* the tricuspid valve. If this assumption is correct, the blood leaving the heart through the aorta must have been predominantly arterial. Secondly, the great size of the pulmonary artery, as compared with the aorta, served the process of oxygenation of the blood well until dilatation and failure of the heart made this no longer possible.

HENRY K. TAYLOR, M.D.

Corvisart's Disease [Tetralogy of Fallot with Right-Sided Aortic Arch]. A. Castellanos, Raúl Pereiras, and Argelio García López. Bol. de la Soc. cubana de pediat. **16:** 329–353, September 1944.

The authors employ the term Corvisart's disease [usually applied to chronic hypertrophic myocarditis]

to designate the combined finding of the tetralogy of Fallot and right-sided aortic arch, an association first described by Corvisart in 1918. Seven cases in children from 4 months to 9 years of age are reported. An extensive history of each is given, and the clinical diagnosis is supported by angiocardiograms reproduced in the text. It is claimed that these are the first such cases to be reported in Cuba and the first to be diagnosed in infants before death.

Emphasis is placed on the necessity of investigating thoroughly the aortic arch of every patient presenting atypical mediastinal symptoms, especially in adult life.

A. MAYORAL, M.D.

Congenital and Infantile Beriberi. David W. Van Gelder and Francis U. Darby. J. Pediat. **25:** 226–235, September 1944.

The authors review the literature on congenital and infantile beriberi and report a case of the congenital type.

An apparently well nourished male infant showed signs of cyanosis immediately after birth. A few fine crackling râles were heard over the bases of both lungs posteriorly. The area of cardiac dullness was increased. The heart rate was so rapid that the apex beat could not be counted. The liver edge was palpable, but the liver did not appear to be enlarged. During the first day, despite continuous administration of oxygen, the infant had several cyanotic attacks. A roentgenogram of the chest, taken at eighteen hours, showed cardiac enlargement. On the second day, the cry was hoarse and feeble, and cyanotic attacks became more frequent and severe. At thirty hours, convulsive movements, with rigidity of the extremities, developed.

Subcutaneous administration of thiamine hydrochloride (50 mg.) at forty-two hours and again eight hours later was followed by dramatic improvement, and the injections were continued at eight-hour intervals for eleven days without apparent toxic effect. The area of cardiac dullness was reduced by the third day following the initial injection, and the heart rate decreased to 160 per minute. A roentgenogram at two weeks of age showed a considerable reduction in the cardiac shadow.

Thiamine chloride was gradually reduced to 50 mg. daily by the third week of life, at which time the pulse rate was 130. When the injections were discontinued, the pulse again rose to 160, but with oral administration of a vitamin B complex it fell, after a month, to 135. By the seventh week of life, the electrocardiogram, which had previously revealed definite evidence of myocardial disease, was normal except for sinus tachycardia. A film of the chest at eight weeks showed a heart of normal size, and the physical findings at that time were apparently normal. One month later dilated pupils and homogeneous, apparent soft opacities of both lenses were observed. (It is believed that the cataracts were present at birth and were due to the metabolic disturbance resulting from the vitamin B_1 deficiency during intra-uterine life.)

The mother of the infant was observed by the authors during the last trimester of her pregnancy. Despite a wholly inadequate prenatal diet, she did not exhibit any marked clinical signs of beriberi. A slight edema during the last trimester was originally attributed to a mild toxemia, despite normal blood pressure and negative urinalyses. Postnatal urinary thiamine assays and dextrose, pyruvate, and lactate blood levels, fasting and following ingestion of dextrose, indicated a state of thiamine deficiency.

The authors mention the possibility that some cases of "congenital idiopathic cardiac hypertrophy" or "status thymicolymphaticus" may actually be instances of unrecognized congenital or infantile beriberi.

THE DIGESTIVE SYSTEM

Argentaffin Tumors of the Gastrointestinal Tract. Gorton Ritchie and William T. Stafford. Arch. Path. **38:** 123–127, September 1944.

Eleven cases of argentaffin tumors were encountered in an autopsy series at the Wisconsin General Hospital. In 3 of these cases (27.2 per cent) the tumor was classed as metastasizing. In one case the mesentery and mesenteric lymph nodes were invaded; in the second, both the mesentery and the liver were involved; in the third, which is reported here, widespread abdominal metastases were found. These cases bring the total number of argentaffin tumors recorded to date to 332, in 126 of which (37.9 per cent) metastases are known to have occurred.

The clinical picture associated with these tumors is variable. In 3 of the 11 cases in this series, clinical evidence of obstruction was present. In the case recorded the chief complaints were pain in the stomach and diarrhea, present for nine months. Roentgen examination revealed a calcified myoma of the uterus, downward displacement of the right kidney, and enlargement of the liver. Complete studies of the gastro-intestinal tract showed no abnormalities. Blood in the stool, detected at first only by the guaiac test, increased until at the time of autopsy a large amount of tarry feces was present below the site of the lesion. The origin of the melena in this case cannot be definitely ascribed to ulceration of the tumor, as the gross picture of the initial lesion was obscured by necrosis of the involved segment of ileum. The appearance of blood in the stools may have been the result of this necrosis in spite of the fact that x-ray studies of the intestine two days prior to death demonstrated no lesion. It is probable that the vascular lesion caused by extension of the tumor was a gradual process with slowly extending necrosis.

Cases of argentaffin tumor metastasizing to the spleen are uncommon. Only two cases have been recorded previously in which the splenic metastases were unquestionably of hematogenous origin, with neoplastic cells deep in the splenic pulp. In the authors' case, the microscope revealed a typical argentaffin tumor primary in the ileum with metastases in the mesentery, the mesenteric lymph nodes, the wall of the gallbladder, the liver, the spleen, and the peritoneal surfaces. From the peritoneal implants there was invasion of both ovaries and the wall of the descending colon. The splenic metastases were microscopic in size. One was found just beneath the capsule and several in the deeper portions of the parenchyma. One small artery was filled with tumor cells.

For some years the argentaffin tumor was considered non-cancerous and the term "carcinoid" was proposed. The increasing number of reported cases with metastases has established the tumor as a true carcinoma. It is proposed that the term "carcinoid" be discarded and the terms "benign argentaffin tumor" and "argentaffin carcinoma" be used. The clinical diagnosis

of argentaffin tumor is of great importance, since the proportion of cases in which the tumor is non-cancerous is high and surgical treatment offers a good prognosis.

Leiomyoma of the Jejunum: Intermittent Melena of Fourteen Years Duration, and Fatal Hemorrhage. Harold A. Hanno and Maurice Mensh. Ann. Surg. **120:** 199–206, August 1944.

A case of leiomyoma of the jejunum, with twenty known episodes of melena over a fourteen-year period and a fatal termination, is reported. Repeated roentgen examinations, including progress-meal studies, revealed no lesion in the upper gastro-intestinal tract or colon. A gastro-enterostomy was performed three years after the onset of symptoms, although at operation no ulcer of the stomach or duodenum could be found. Several gastroscopic examinations in the period following gastro-enterostomy showed no evidence of bleeding points or ulceration either in the body of the stomach or the well visualized stoma. A tumor of the jejunum was found at autopsy.

This case emphasizes the fact that much too frequently the presence of a neoplasm of the intestine is not suspected. This possibility should be considered in any patient who has repeated episodes of melena in the absence of a demonstrable lesion in the upper gastro-intestinal tract or colon, and in any patient with recurrent partial or complete obstruction of the small bowel.

Roentgenography is of assistance in the diagnosis in many but not all cases of tumor of the small bowel. There are several reasons for the failure of this procedure. Perhaps the most important of these is that the clinician fails to suspect a tumor and, as a consequence, the roentgenologist, not being forewarned, does not look for such a lesion with sufficient care or persistence. Secondly, subserosal tumors, which accounted for two-thirds of the cases of myoma in one series, are unlikely to produce a marked subtraction defect in the silhouette of the barium-filled small bowel. Thirdly, due to the extensive overlapping of small bowel shadows, a defect may easily be overlooked. Repeated progress-meal studies and, in some cases, the introduction of barium directly into the jejunum through a tube are prerequisites for adequate demonstration of small intestinal neoplasms. If obstruction is present, plain films of the abdomen will reveal the usual roentgen evidences of dynamic ileus, and in those cases of colonic involvement by an intussuscepting mass in the small intestine, barium enema studies are of value.

Diverticula and Duplications of the Intestinal Tract. J. L. Bremer. Arch. Path. **38:** 132–140, September 1944.

While this paper is not written from the point of view of the radiologist, he will find its discussion of those anomalies of the intestinal tract known as "duplications" or "reduplications," "enteric" or "enterogenic cysts," "ileum duplex," and "giant diverticula" of interest. The author's conclusions constitute a good summary:

"The group of anomalies comprising the enterogenous cysts, intestinal duplications and the like is divisible into two smaller classes on the basis of embryologic origin. Most of the spherical cysts are derived from true diverticula, which are frequently found projecting from the ventral or antimesenteric surface of the tube in embryos of the eighth or ninth week and are normally absorbed later. Abnormally they continue to grow: If restricted by the intestinal muscle, they bulge within the lumen, but if they pierce the muscle layers, outward expansion is not limited and they may become large cysts attached to the intestine. Their wall is necessarily thinner than the gut wall.

"A few of the spherical and most of the tubular structures represent true duplication, originating by an abnormal persistence of the vacuoles normally present among the massed cells of the 'solid stage' of the intestine, a phenomenon of growth in embryos of the sixth or seventh week. By the confluence of a chain of vacuoles a new channel is formed, parallel to the original lumen, and becomes separated from the latter by a union of the intestinal layers between the two. Since the duplication develops within the intestine, the outer wall of the duplicate portion always contains all of the tissue layers of the intestine. The duplicate lumen usually lies between the leaves of the mesentery but may be entirely separated, with a mesentery derived by the splitting of the original. It may open into the main lumen at one or more places, or become a closed cyst. Theoretically, three or more channels are possible, the main lumen and two or more confluent chains of vacuoles.

"The duplicate structures assume many forms . . . and are often associated with other anomalies. In the tubular portions the mucosa tends to resemble that of the parent tube, but in bulbous or cystic portions it changes to the gastric type. Great internal pressure may destroy mucosa of any type."

Congenital Anomalies of the Lower Part of the Rectum: Analysis of Sixteen Cases. Madison J. Lee, Jr. Am. J. Dis. Child. **68:** 182–189, September 1944.

Congenital malformations of the anus and rectum are uncommon, occurring in 1 out of 5,000 infants. They result from imperfect separation or obliteration of cavities and failure of proper rupture of the anal membrane. This is indicated by a review of the embryology of the five- to eight-week fetus from the formation of the urogenital sinus and cloaca to its separation into the urogenital system and rectum and concurrent dimpling of the proctoderm with formation and eventual dissolution of the anal membrane. It is mentioned incidentally that the external anal sphincter develops from the local mesenchyme, independent of the lower bowel segment, and may be present notwithstanding local anomalies.

The author reports in adequate detail 16 cases of anorectal malformations collected from three hospitals over a four-year period. He has used the classification of Ladd and Gross (Am. J. Surg. **23:** 167, 1934), which is as follows:

Type 1. Incomplete rupture of the anal membrane or stenosis at a point 1 to 4 cm. above the anus.

Type 2. Imperforate anus due to a persistent anal membrane.

Type 3. Imperforate anus with the rectal pouch separated from the anal membrane. The rectal pouch is a closed sac.

Type 4. Normal anus and anal pouch with a blind rectal pouch. There is either membranous obstruction or considerable separation between the two pouches.

Eleven of the 16 cases were of Type 3, and 4 of Type 1. The remaining case was considered a combination of Types 1, 2, and 4. No case of pure Type 2 was included in this series. It is believed that the simple remedy of cruciate membrane incision may have proved so satisfactory in these cases that they failed to attract any special attention.

Absence of meconium, signs of abdominal obstruction, bulging of the perineum on straining to defecate, ribbon stools, and the appearance of meconium or fecal material from the urethra, vagina, or sinus openings indicate the presence of a rectal anomaly. Roentgen examination aids in the precise diagnosis and localization of the defect needed for proper surgical treatment. Blind rectal pouches can often be delineated by fluoroscopic or roentgenographic study. Fistulas can be traced with the use of iodized oil.

Associated anomalies are rectovesical, rectourethral, and rectoperineal fistulas in the male infant; rectovaginal, rectovesical, rectoperineal, fistulas and fistulas between the rectum and the fossa navicularis in the female.

The case of combined anomalies of Types 1, 2, and 4 is of interest. The patient was a white male infant born with an apparent imperforate anus and hydrocele. A blunt instrument was pushed through the membrane at the anal dimple, and continuity with the rectum was established. Meconium still did not pass, and a roentgen examination showed gas-filled bowel terminating in a blind pouch about 3 cm. proximal to the anal marker placed in the dimple, and 1.5 cm. anterior to the sacrum. Instillation of iodized oil through the perforated anal site showed the lower pouch to be 3.5 to 4 cm. in depth, extending to the gas-filled loop, adjacent to the sacrum, and having a filiform fistula passing to the neural canal between the fourth and fifth sacral segments. Meconium was found in the urine, indicating a fistula between the sigmoid and urinary system. Despite a cecostomy for relief of intestinal obstruction, the patient died. Autopsy confirmed the above findings and established the sigmoid fistula to be between the blind pouch and the prostatic urethra.

Causes of death in 5 additional patients, all with Type 3 anomalies, included intestinal obstruction, urinary tract infection, and congenital heart defect. Of the 6 Type 3 patients still living, treatment had been completed in 3, with good results in 2 and fair anal function in the third. The other 3, at the time of the report, still needed additional plastic perineal repair. The results were good or fair in all Type 1 cases.

LESTER M. J. FREEDMAN, M.D.

Hepatoma of the Liver with Metastasis to Bone Occurring in a Patient Known to Have Had Advanced Cirrhosis Eight Years Previously. Maurice Mensh and Harold A. Hanno. Gastroenterology **3:** 206–213, September 1944.

In 1934, a 50-year-old laborer was admitted to the Graduate Hospital, University of Pennsylvania, with an intractable duodenal ulcer. Because of lack of response to an adequate medical regimen, subtotal gastrectomy was advised. At operation, however, a small hobnail liver was found and a gastro-enterostomy was performed. At this time, liver-function tests revealed no evidences of hepatic dysfunction except for slight dye retention with the 5-mg. dose of bromsulphalein, a urobilinogenuria of 1:80, and slight hypoproteinemia. Clinically the patient manifested none of the findings usually associated with portal cirrhosis. He returned to the hospital eight years later with jaundice, anasarca, and a large mass in the right upper quadrant of the abdomen. A clinical diagnosis of hepatoma of the liver was then made. This was confirmed at autopsy, and portal cirrhosis and metastases in the ribs and lung were found.

The absence of abnormalities in a number of tests of liver function and lack of any of the clinical features commonly encountered in cirrhosis at a time when the liver of this patient was frankly cirrhotic emphasize the fact that any given test of liver function may be negative despite the presence of a cirrhosis. This case shows that a cirrhotic liver may well antedate by a considerable number of years the manifestations of clinical portal cirrhosis. It illustrates, also, the association of hepatoma and cirrhosis of the liver and conclusively shows, in this one instance at least, that the cirrhosis preceded the hepatoma by several years. From recent reports it is apparent that, although osseous metastases from hepatomas are not common, they occur less rarely than is ordinarily supposed.

Papilloma of the Gall Bladder. William Greenwald. Surgery **16:** 370–376, September 1944.

There is considerable diversity of opinion regarding the occurrence of papillomas of the gallbladder. A large number have been reported from the Mayo Clinic (Phillips: Am. J. Surg. **21:** 38, 1933), whereas Kerr and Lendrum (Brit. J. Surg. **23:** 615, 1936) found but 21 "authentic" examples in the literature up to 1936. The author reports 2 cases.

Case 1: A 46-year-old white woman complained of pain in the right upper quadrant one-half to four hours after meals, particularly after ingestion of fried or fatty foods. Six months before admission she had a severe attack of colicky pain in the right upper quadrant, radiating around the abdomen and back toward the right scapula, accompanied by nausea and vomiting. The blood count was not significantly abnormal. Gastric analysis showed a low hydrochloric acid. The gallbladder was well visualized roentgenographically and of normal size and shape. Emptying was slightly delayed. A small negative shadow was thought to represent a stone or papilloma but, because of its consistently fixed position in all views, the latter possibility was considered more likely.

The gallbladder, though apparently normal, was removed and, when opened, showed a papilloma the size of a split pea. Microscopically this proved to be an adenomatous papilloma. Recovery was complete.

Case 2: A 36-year-old white woman complained of slight discomfort after eating. One week previously, she had experienced a severe attack of colic in the right hypochondrium, accompanied by nausea and vomiting. Routine physical and laboratory examinations revealed nothing of significance. X-ray studies showed a small negative shadow in a well filled gallbladder, slightly larger than normal. The gallbladder emptied fairly well after the fatty meal, and the negative shadow persisted. Because of its relatively fixed position in all views, a diagnosis of papilloma was made. As in the first case, the gallbladder appeared normal at operation but was removed because of the roentgenographic findings and previous history of colic. A small papil-

loma was found in the fundus and the mucosa showed the typical picture of strawberry gallbladder.

The author concludes that (1) papilloma of the gallbladder is of rather rare occurrence; (2) it may simulate any type of biliary disease; (3) the diagnosis may be made preoperatively upon roentgenographic study; (4) at operation the gallbladder may appear entirely normal but should be removed if there have been symptoms of biliary disease and if no other intra-abdominal lesion can be found to account for these.

J. E. WHITELEATHER, M.D.

THE PERITONEUM

Spontaneous Pneumoperitoneum from an Unknown Cause: Report of a Case. Nathan Sidel and Abraham Wolbarsht. New England J. Med. **231:** 450–452, Sept. 28, 1944.

An unusual case of pneumoperitoneum is presented, with complete lack of any history or physical findings indicating perforation of an abdominal viscus. Roentgenologic examination of the intestinal tract and of the lungs failed to reveal any possible way for air to enter the peritoneal cavity.

This is the fourth case of spontaneous pneumoperitoneum of unknown origin to be reported in the literature.

JOHN B. MCANENY, M.D.

THE SPLEEN

Traumatic Rupture of the Spleen. Gordon M. Perisho and Morris Steiner. U. S. Nav. M. Bull. **43:** 216–222, August 1944.

Traumatic rupture of the spleen is a dramatic and grave calamity, the mortality among untreated cases having been reported as 90 to 100 per cent. Prompt diagnosis, however, and early surgical intervention offer an excellent chance for recovery.

There is usually a history of a blow on the left side of the lower thorax, back, or abdomen. If a complete laceration of the spleen is produced, through the capsule, there will be rapid continuous hemorrhage into the peritoneal cavity, with its attendant signs and symptoms. There may, however, be (*a*) a minor superficial capsular rupture with ecchymosis and slight bleeding, (*b*) an intrasplenic hematoma with subcapsular bleeding and subsequent rupture of the capsule followed by rapid intraperitoneal hemorrhage, or (*c*) a parenchymal and capsular rupture with slow initial bleeding and subsequent rapid free hemorrhage.

The classic picture of acute hemorrhage following rupture of the spleen is familiar: shock, air hunger, rapid pulse, rigidity and dullness in the left upper abdomen, pain referred to the left shoulder, and laboratory evidence of progressive secondary anemia. To delay diagnosis for this fully developed picture, however, is to invite death from hemorrhage before surgical intervention can be attempted. Since splenectomy is the only effective treatment, early diagnosis is imperative. It is emphasized that intraperitoneal hemorrhage does not necessarily cause severe pain, tenderness, and rigidity but may be extraordinarily silent. There may be a feeling of uneasiness in the abdomen and pain referred to the left shoulder (Kerr's sign). The pulse rate may at first stay within normal limits, later rising suddenly to 120–140. Even with gross rupture the symptoms and signs may be slight until, abruptly and rapidly, the patient collapses.

In delayed hemorrhage, the interval between injury and the onset of clinical signs ranges from forty-eight hours to six months, the usual latent or silent period being three to six days. The onset of delayed bleeding is very abrupt and is rapidly followed by collapse, shock, and other classic symptoms of primary hemorrhage. The greatest aid in diagnosis is to have this possibility in mind and keep every patient with a history of trauma to the splenic region under close observation.

The assistance that x-ray findings can give in the diagnosis of rupture of the spleen has not been appreciated. These are based on the anatomico-pathologic changes. Suggestive indirect findings are (1) elevation of the left diaphragm and (2) fractures of the left lower ribs. In the event of delayed or secondary rupture, where the capsule remains intact, the only change demonstrable by x-ray is enlargement of the spleen shadow, which is normally quite variable. Where the capsule is ruptured, however, with formation of a perisplenic hematoma, certain changes occur which are very suggestive. The perisplenic mass disturbs the normal relationships and location of adjoining structures; the stomach is displaced to the right, possibly with a concave indentation on the greater curvature; the splenic flexure and left half of the transverse colon are displaced downward. The area normally occupied by these structures is filled by a homogeneous shadow, not normally seen in the left upper quadrant. There may also be a reflex ileus.

A report of a case in an eleven-year-old boy with delayed rupture and typical x-ray findings is presented.

FRANK KINSEY, M.D.

THE SKELETAL SYSTEM

Iodized Oil Myelography of the Cervical Spine. Observations on the Normal and on Five Patients with Ruptured Intervertebral Discs of the Lower Cervical Spine. Bernard S. Epstein and Leo M. Davidoff. Am. J. Roentgenol. **52:** 253–260, September 1944.

The authors have studied 5 patients with rupture of the nucleus pulposus of the lower cervical spine. These were from a group of 76 patients with ruptured disks, in 71 of whom the site was the lower lumbar region.

Myelography was performed after the injection of 1.5 to 2 c.c. of pantopaque or lipiodol into the lumbar subarachnoid space. The patient was tilted and the movement of the oil column was observed roentgenoscopically. It was necessary to invert the patient on a tilting table to an angle of 70 to 85 degrees for the oil to enter the upper thoracic and lower cervical regions. Observations were made on normal persons, also, so that abnormal behavior and appearance of the opaque medium in the spinal canal could be appraised.

In the patients with rupture of the lower cervical nucleus pulposus the oil column was halted briefly, but longer than in the normal, at the level of the lesion, changing in appearance to a large globule with a flat or convex base directed cephalad. After a few seconds a thin trickle of oil appeared either to one or both sides of the lesion. It was not necessary to allow the oil to enter the cranial cavity. Roentgenograms, viewed in the position in which they had been taken, showed a characteristic appearance like that of an inverted "U" or "L" with broad base and thread-like arms, with oil droplets beneath and between the latter.

The oil did not enter the axillary pouches as it does normally.

The observations indicated that ruptured disks protruding into the lower cervical canal may result in either no obstruction or in partial or complete block. When there was little or no block, the myelogram resembled those for intramedullary cord tumors, showing a cap-like defect. With a herniated disk, however, the cap-like defect is transitory and, unless watched for carefully, may be overlooked. In the presence of intramedullary cord tumors the defect is permanent and lipiodol is seen in the axillary pouches. When complete block occurs, it is difficult to rule out an extramedullary tumor. Such tumors, however, are often associated with changes in the adjacent osseous and soft-tissue structures.

The distribution of pain in the authors' cases was bizarre. There was little pain referable to the cervical area. One patient had pain at the base of the neck. Another had pain in the lower lumbar region and 3 had no back pain. Weakness, paresthesias and pain in both upper limbs were observed in one patient. Right arm symptoms were present in 2 patients and one had sensory disturbances in the left arm. Lower extremity pain, weakness, and paresthesias occurred in 4 patients. The symptomatology in all 5 cases reported here was referable to the dorsal funiculi, the pyramidal tracts, and the lateral and ventral spinothalamic tracts. Root pain was observed, but was not a predominating symptom. CLARENCE E. WEAVER, M.D.

Adolescent Kyphosis. T. J. B. A. MacGowan. Lancet **1:** 211–214, Feb. 12, 1944.

If the vertebral nucleus is destroyed before ossification of the vertebral body is complete, owing to failure of the cartilaginous disk to retain the nucleus or to softening of the vertebral body, the axis of weight-bearing is transferred anteriorly and the axis of motion posteriorly. If the patient is adolescent, the epiphysis will be subject to trauma. Abnormal ossification follows, leading, after a period of increased growth, to premature closure of the epiphysis, failure of anterior vertebral ossification, and wedge formation of the vertebral bodies. The mobile stage of kyphosis merges into the fixed, and thence into the fixed arthritic stage.

In the early mobile stage, the deformity, being correctable, is mainly a soft-tissue defect. The spine is held at the limit of flexion, but extension is still possible. In the late mobile stage, this extension is less and bony changes occur without much alteration in the roentgen picture. Probably at this stage nuclear prolapses have followed nuclear displacement, under continued flexion strain. If the epiphysis appears, it will be now subject to a trauma, growth of bone will be disordered, and by the early rigid stage, roentgen changes can be seen in an area of the vertebral body which, in the adult, would be in the region of the junction of the anterior third and posterior two-thirds of the vertebral end plates. In the late rigid stage, wedge-shaped bodies are the rule, owing to the continued growth of the body centers and a process of modeling which flattens out the step between the arrested end plates and the projecting area of bone formed by the center.

Nuclear prolapses, to be visible roentgenologically, must be surrounded by a shell of compact bone. They are therefore seen at a late stage and always in the area of the nucleus, or posterior to that region. In the late arthritic stage the ordinary degenerative changes include thinning of and ossification or calcification in the intervertebral disks, formation of anterior vertebral spurs, ossification in the posterior ligaments, and ossification or calcification in the soft tissues in or around the vertebral disk.

The x-ray appearance of the normal spine at various ages is also discussed.

Roentgenographic Diagnosis of the Small Central Protruded Intervertebral Disc, Including a Discussion of the Use of Pantopaque as a Myelographic Medium. Benjamin Copleman. Am. J. Roentgenol. **52:** 245–252, September 1944.

There is a small group of patients with disk protrusions in which the characteristic lateral defect is not found during the course of the usual myelographic examination. The author injects 3 c.c. of pantopaque firmly and steadily. After the injection, the patient is placed prone and the lumbar puncture needle left in place. The table is then tilted so that the opaque fluid descends the spinal canal slowly and the advancing margin of the column is watched for slight deformities. "Spot" roentgenograms are made. The column is also followed as it ascends the spinal canal, and oblique observations and "spot" roentgenograms are made. Oblique views have been found more helpful than lateral views. After the examination the oil is aspirated.

Five cases are reported in which a small central protruded intervertebral disk was demonstrated by myelographic study and was found at subsequent operation. In 4 of these cases the outline of the oil column was practically normal when it completely bridged the level of the protrusion, aside from asymmetry of the nerve exits. In one case there was a slight deformity, which in itself was insufficient to warrant a positive diagnosis. Detection was made by careful observation of the slowly advancing edge of the pantopaque column to outline a small herniation. There was no defect of the nerve sleeves.

The myelographic examination is greatly facilitated by the use of pantopaque, a new medium developed especially for this purpose. It is of low viscosity, unproductive of reactions, tends to remain homogeneous, and is not excessively opaque.

CLARENCE E. WEAVER, M.D.

Low Back Pain: Subluxations of Apophyseal Joints and Fractures of Articular Facets. Wendell G. Scott. U. S. Nav. M. Bull. **43:** 234–240, August 1944.

In reviewing the records at a large Naval Air center, the author found examination of the lower spine for low back pain to be the third most frequent roentgenologic procedure. The conditions that are most difficult to diagnose make up a small but significant group including subluxations of the apophyseal joints and fractures of the articular facets.

Routine examination of the lower spine calls for four projections; anteroposterior, lateral, and right and left oblique. Some suggestions are offered about taking the oblique films: (1) Allow sufficient leeway in the angle at which the side of the body is raised, because of the variation in the obliquity of the articular facets among different patients and between vertebrae in the same person. The angle ranges from 30 to 45°.

Keep the patient in the initial position until the film is developed to determine whether further adjustment is required for a proper view of the facets. (2) Take the opposite oblique film at this selected angle. (3) Take sufficient exposures at various angles to delineate fully all the facets. (4) Place a translucent cotton roll about 3 in. in diameter just above the crest of the ilium to prevent sagging of the lumbar spine.

The roentgenologic diagnosis of subluxation of the apophyseal joints has not received the attention it deserves. Anatomically, these are true diarthrodial joints formed by the opposing facets of the vertebrae above and below. The anterior surfaces of these facets form the posterior wall of the intervertebral foramina, through which the lumbar nerve roots pass. Injury here may produce edema sufficient to compress the nerve root. These joints are very active and their range of motion is so great that in the young the opposing facets may slip past each other between hyperflexion and hypertension, to increase or decrease the intervertebral foramina from 50 to 75 per cent without producing compression on the nerve roots. This range of motion decreases with age and at fifty may not exceed 30 per cent of their length. Overriding is therefore no criterion for diagnosing a subluxation on the inference that the stretching of the joint capsule causes pain. Neither is it possible to estimate the degree of narrowing of the foramen necessary to cause pain by compression of the nerve root, since normally, in extreme motion, there remains considerable free space between the tip of the facet and the pedicle of the vertebra above. Subluxation of the apophyseal joints is defined as an incomplete dislocation caused by a thinning of the intervertebral disk with impingement of the facets on the pedicle and lamina of adjacent vertebrae. The diagnosis depends on two associated factors: (1) narrowing of the intervening intervertebral disk space; (2) sufficient dislocation of the facets to produce impingement of the tip of the superior facet on the pedicle of the vertebra above and the tip of the inferior facet on the lamina of the vertebra below. This impingement causes sclerosis, eburnation, and erosion, the degree depending on the duration and amount of pressure produced. The tips become worn and flattened.

Subluxations in the anteroposterior and lateral planes are possible, depending on the anatomical direction of the facets in different subjects.

The clinical picture of apophyseal subluxation is one of chronic low back pain, usually of long standing, most frequently in the fourth, fifth, and sixth decades of life. It is described as a dull ache, and tenderness can be elicited. The pain may radiate along the sciatic nerve and may be sufficiently disabling to prevent heavy labor. As a rule, when the pain has a sciatic distribution, there is an associated protrusion of the intervertebral disk causing direct pressure on the nerve root. This can be shown by spinal myelography. The importance of this is that, if these two conditions coexist, both must be surgically corrected to relieve the sciatic pain.

Fractures of articular facets involve similar structures and may give clinical symptoms similar to those of apophyseal subluxations. These fractures usually accompany any fracture of a vertebra with anterior dislocation of the vertebral body on the vertebra below. They are easily recognized, but oblique roentgenograms are necessary for recognition of isolated fractures of the facets and are indicated in patients with a history of back injury when anteroposterior and lateral films are normal. These isolated fractures are infrequent and are usually produced by extreme hyperextension or a twisting of the trunk or both. The pain is localized, disabling, and persistent, relieved by immobility and recurring with movement. Small fractures of the tip may heal spontaneously but those across the base of the facet usually require surgery.

Roentgenologically, these fractures must be differentiated from accessory ossicles or persistent epiphyses. The latter are often multiple and bilateral. They are smooth and well rounded and are surrounded by a cortex, while the fractures have irregular serrated lines with comminuted fragments and are present only in patients with a history of trauma.

FRANK KINSEY, M.D.

Ankylosing Spondylitis. Ernest Fletcher. Lancet I: 754–756, June 10, 1944.

Sixty-eight cases of ankylosing spondylitis are analyzed. Of the 36 males, 21 had sedentary occupations, while 15 did manual work. Thirteen females were housewives, 7 domestic workers, 3 nurses, and 9 office workers. The average age at the time of the diagnosis was 38.4 years for males and 40 for females. In the male the average time between the onset of symptoms and the time of diagnosis was 2.9 years, and in the female 2.5 years. Forty patients had girdle pain as the initial symptom; 13 had cervical pain radiating down the arms; 5 had pain over the dorsal spine, radiating to the epigastrium; 18 had lumbar pain, and in 12 there was typical sciatic radiation. In 22 patients there was a non-radiating pain in the back. Two patients had pains all over the body. Four had pains referred to the peripheral joints.

The roentgen changes in ankylosing spondylitis consist of a destructive process which first shows itself as an irregular widening of the joint surfaces with apparent serration of their edges. Definite sclerosis sometimes follows in the surrounding bone; later the cartilage is destroyed and the joint space narrows and finally becomes ankylosed. The early changes are referred to as non-specific sacroiliac disease or "sacral focus." X-ray changes later in the disease include the calcification of spinal ligaments, superficial osteitis of the os calcis, the tuber ischii and the patella, and, rarely, involvement of the symphysis pubis. Three cases were not classified because the roentgenograms were not available for rechecking. The remaining 65 cases were seen at the following stages: sacral focus only, 17; sacral focus and involvement of spine, 10; ankylosed sacroiliac joint and involvement of spine, 30; special group with clear sacroiliac joints, 8. No significant difference in sex distribution, sedimentation rate, age, length of history, treatment, or prognosis could be demonstrated among these groups.

Cases in this series are compared with those of the von Bechterew and Marie-Strümpell type.

Non-Injection Method for Roentgenographic Visualization of the Internal Semilunar Cartilage. Technique and Analysis of Results in 709 Examinations. Leonard Long. Am. J. Roentgenol. **52:** 269–280, September 1944.

For demonstration of the semilunar cartilages, the author uses the method outlined by Reynolds in a

paper (unpublished) presented in 1941. The technic consists essentially in making an anteroposterior exposure about three seconds after the end of a maneuver consisting of strong traction and firm internal rotation and abduction of the fully extended leg. The thigh is firmly held, and a fixed padded fulcrum is used against the lateral aspect just above the knee. The apparatus used is described. Counter traction is supplied by having an assistant at the opposite end of the table hold the patient's pelvis. Results of 709 examinations on 291 patients are grouped and analyzed. There were 284 asymptomatic knees, and in 191 of these (67.2 per cent) the internal cartilage was outlined. Of 15 cases which were found to be pathological at operation, 13 (86.7 per cent) showed no cartilage in the roentgenograms. In the other 2 distinct cartilage shadows were seen, but there was a defect conforming to the "air replacement" shadow. Repeat examinations on asymptomatic knees increased the percentage of demonstrable cartilages. In the groups which had definite or probable pathologic cartilage there was a change from non-visualization to visualization in only 1 out of 27 cases.

Abduction places the internal lateral ligament and capsule under tension and, since the internal semilunar cartilage is attached to the capsule, it is held in position midway between the separated articular surfaces of the tibia and femur, allowing both its superior and inferior margins to be outlined. The peripheral portion is wedge-shaped, with internal extensions representing the anterior and posterior horns very often visible.

Experience seems to indicate that non-visualization is of corroborative value in diagnosing a pathologic condition of the cartilage. When an abnormal cartilage is demonstrable, the pathologic condition is often apparent as a defect, thinning, or absence of a distinct wedge (suggesting dislocation). The procedure outlined has none of the disadvantages of the injection methods. CLARENCE E. WEAVER, M.D.

March Fracture: An Analysis of Two Hundred Cases. George R. Krause and John R. Thompson, Jr. Am. J. Roentgenol. **52:** 281–290, September 1944.

Following a general discussion in which they define march fracture, outline the four stages recognizable roentgenographically, and analyze the theories that have been advanced in explanation of the occurrence, the authors report their observations on a group of 200 consecutive patients seen in an Army Station Hospital. Eighty per cent of the fractures in the group occurred during the first six months of military service; 81 per cent of the patients were between eighteen and twenty-nine years old. Occupation prior to induction had no relation to the occurrence of a march fracture. Fractures occurred in both feet in 9 cases, and there were 9 instances of fracture of more than one metatarsal in the same foot. The third metatarsal was most frequently involved, the second metatarsal slightly less frequently, and the fourth metatarsal only occasionally. Body build seemed to play no part in the production of the fracture.

It is evident from an analysis of the authors' cases that the presence of a short first metatarsal had no material effect on the site of the fractures, nor was it a factor in their production. Width of the foot did not appear to play a role. There were no instances of osteoporosis nor was there evidence of any systemic disease.

Rest in bed and local application of an ice bag until the edema subsides, followed by the use of a metatarsal bar on the shoe when walking is resumed, will shorten the period of disability. This is especially true if treatment is begun soon after the onset of symptoms. A plaster cast is not necessary and, indeed, delays the soldier's return to full duty, due to the development of osteoporosis. CLARENCE E. WEAVER, M.D.

Fractures of the Carpal Scaphoid in the Canadian Army. A Review and Commentary. J. C. Dickison and J. G. Shannon. Surg., Gynec. & Obst. **79:** 225–239, September 1944.

The authors present a study of 257 cases of fractured carpal scaphoids occurring in the Canadian Army overseas.

The anatomy and relationships of the scaphoid are discussed. Ligamentous attachments to the scaphoid bear an important relation to the mechanics of fracture. Very strong ligaments secure the distal half of the scaphoid to the multangulars and capitate. Similarly the proximal half has a strong attachment to the lunate. Thus any strain placed on the midcarpal joint will also occur at the center or waist of the scaphoid bone. The blood supply of the scaphoid is carried by the ligaments attached about the tubercle and the dorsal surface in the region of the waist of the bone. Therefore, the more proximal the fracture, the greater is the likelihood of a disturbance of the circulation to the proximal fragment.

Three types of fracture are described: fracture of the tubercle, fracture of the body, and fracture dislocation. Fractures of the body are further differentiated into "waist" and proximal pole fractures. Fractures just proximal to the waist are included with the waist fractures. Most of the body fractures are caused by a fall on the outstretched hand with the wrist joint forced into hyperextension and radial deviation. With extreme radial deviation about two-thirds of the scaphoid is fixed between the capitate and the radius and the fracture occurs in the region of the waist. With less deviation, less of the scaphoid is fixed and the fracture occurs more proximally. The tubercle fracture is caused by forced extension of the wrist in ulnar deviation. This is an extra-articular avulsion fracture and the blood supply to both fragments is always adequate.

Only one case of bipartite scaphoids was found in checking the radiographic reports on nearly one thousand wrists.

In this series union occurred in all simple fresh waist fractures. The major problems of fractured scaphoids arise from failure to make an early diagnosis. The diagnosis can be positively established or excluded only by roentgenograms taken in the anteroposterior, lateral, and oblique positions. The oblique is the most important view, and frequently several such roentgenograms are necessary. To overlook a faint fracture line is to court disaster. Cases in which fracture is suspected clinically but cannot be demonstrated by roentgenograms should be treated as fractures until repeated roentgen studies in two or three weeks enable one to reach a definite decision.

Displacement is a rare but serious complication. Six of the waist fractures diagnosed early showed displacement, and in 4 of these non-union occurred. If there is

irreducible displacement, operative removal of the displaced fragment is advisable before reactive hypertrophic changes take place.

Proximal pole fractures were found to be far more infrequent than waist fractures and required a longer period for union, an average of 20 weeks as compared to 12.5 weeks. In this group vascular disturbance, delayed union, and non-union were more common. Avascular necrosis only delays union; it is not necessarily a precursor of non-union.

Seventy cases in this series were not diagnosed until at least two months after the injury and in these the results of treatment were frequently disappointing. No fracture united with immobilization only if the diagnosis was made later than nine months after the injury. These fractures showed sclerosis of the margins.

The authors believe there is only one indication for bone grafting and that is non-union, as shown by sclerosis of the fracture margins. In cases with union following operation the minimum period of postoperative immobilization was fourteen weeks.

There were 11 cases of fracture dislocation and in each the proximal fragment retained its relationship with the semilunar and the distal fragment with the capitate.

In summary, the authors re-emphasize the fact that the primary problem is early diagnosis. Roentgenographic examination should be made during the course of treatment, with the surgeon handling the wrist while it is out of the plaster. How to obtain union consistently in fractures with a late diagnosis is an unsolved problem. Those with degenerative arthritis must be treated as arthritis problems. The period required for healing any fractured scaphoid may be very long. CHARLES R. PERRYMAN, M.D.

Fractures of the Carpal Navicular. Herbert E. Hipps. U. S. Nav. Med. Bull. **43:** 467–476, September 1944.

The author reviews 37 cases of fracture of the carpal scaphoid. Fresh fractures may not at first be visible on the ordinary flat-hand anteroposterior or lateral film, but if tenderness on motion persists at the end of three weeks, further roentgen study will usually reveal the diagnosis, since enough absorption will have taken place to make the fracture line clearly discernible. In ununited fractures the fracture line is indicated by a zone of marginal absorption in one or both fragments. In early non-union this may be the only finding, but in a later stage marginal sclerosis will be apparent and cavitation will occur in bone adjacent to the fracture line or at some distance.

The present series included 26 fresh fractures and 11 cases of non-union. The fresh fractures, with 3 exceptions, and selected cases of non-union were treated by complete immobilization in a non-padded plaster cast, so applied that motion of the fingers was not limited. In the 23 fresh fractures thus treated firm union occurred in an average period of eighty-seven days. In the other 3, results were poor. In one of these no cast was applied; in another the cast was padded, and in the third the plaster was removed after thirty days. Union was also obtained in 5 of the 6 cases of ununited fracture in which the non-padded cast was used.

In ununited fractures roentgen examination was found to offer certain criteria upon which a choice of treatment could be based. Union following immobilization by the method described could be expected under the following conditions: a narrow fracture line; a good blood supply to both fragments, indicated by their equal density; absorption and sclerosis on both sides of the fracture line; slight or no marginal sclerosis. Open operation with freshening of the fracture surfaces and drilling of the fragments followed by immobilization is indicated in the presence of a narrow fracture line with marginal sclerosis and avascularity of one fragment. A bone graft operation (plus prolonged fixation) becomes necessary if there is a wide fracture line. STANLEY H. MACHT, M.D.

Perilunar Dislocation of the Carpal Bones and Dislocation of the Lunate Bone. W. Russell MacAusland. Surg., Gynec. & Obst. **79:** 256–266, September 1944.

The author recognizes two types of dislocation involving the lunate or semilunar bone: the perilunar dislocation, in which there is volar or dorsal luxation of the carpal bones around the lunate, and the dislocation of the lunate bone itself either dorsalward or volarward. The former may be accompanied by a fracture of the navicular bone or of the radial or ulnar styloid process. These dislocations are not of frequent occurrence, the author having encountered only 24 cases in twenty-seven years of orthopedic practice. In 16 cases there were associated fractures.

Diagnosis requires a true lateral, as well as an anteroposterior roentgenogram of the wrist. Stereoscopic views give the most accurate picture.

The greatest difficulty in treating these cases is early recognition. A fresh dislocation is considered one that is less than two weeks old, and in such cases reduction can usually be accomplished by conservative measures, whereas later reduction even by operative intervention may be too traumatic to be feasible. Untreated and inadequately treated injuries result in impaired function due to damage to soft tissues and tendons.

Open replacement is indicated in cases of more than two weeks' standing or in a fresh case associated with considerable damage to the joint structures or to the median nerve, where manipulative replacement would cause further trauma. It is also recommended in uncomplicated dislocation of the lunate bone when manipulation fails or when the case is treated within six weeks of injury. Dislocations of more than six weeks' duration are best treated by excision, which yields, on the whole, a useful wrist and joint. Operative reduction is more likely to succeed in incomplete dislocation than in complete dislocation, since in the former there are sufficient ligamentous attachments to ensure adequate blood supply to the lunate.

Perilunar dislocation in elderly patients with arthritic joints, when complicated by excessive damage to the tissue structure and a disturbance of circulation, are best treated by an arthrodesis of the lunate, navicular, and capitate bones. DAVID KIRSH, M.D.

Paget's Disease: Its Pathologic Physiology and the Importance of This in the Complications Arising from Fracture and Immobilization. Edward C. Reifenstein, Jr., and Fuller Albright. New England J. Med. **231:** 343–355, Sept. 7, 1944.

Following a discussion of normal bone physiology and histology, the authors review the morbid anatomy of Paget's disease. This condition is defined as a localized bone disease, since one can usually find a sharp

line of demarcation between normal and diseased bone. Localization is offered as evidence against a metabolic or endocrine etiology.

Paget's disease has much in common with the actual bone lesion of osteitis fibrosa generalisata. In both conditions there are extreme vascularity, marked fibrosis, and equal bone destruction and bone repair. The architecture of the two conditions differs. In Paget's disease the trabeculae start nowhere and end nowhere, and the cement lines within the trabeculae show a bizarre arrangement.

To determine whether bone destruction or bone production is the initial process, one must examine the advancing edge of the lesion. This shows that destruction precedes production. Microscopically numerous osteoclasts are seen in the advancing part of the lesion but no bone formation or osteoblasts.

Two interesting case histories are presented. The first patient was a 58-year-old male with Paget's disease, who fractured the neck of his right femur for the third time. He consumed large quantities of milk even while immobilized for treatment. After two weeks he complained of anorexia, headache, and a peculiar sensation of dryness in his throat; then epigastric distress, nausea, and occasional vomiting began. The specific gravity of the urine became fixed at 1.008 and the blood calcium was found to be 13.4 mg., serum phosphorus 4.2 mg., and serum phosphatase 4.3. With elimination of milk from the diet and increase of other fluids, the patient became much better and the urine and blood findings returned to normal. The second case was similar to the first.

The important feature of these cases is the danger of a chemical death when a patient with Paget's disease is immobilized. The peculiar sensation of dryness in the throat, with nausea and vomiting, seems to be related to hypercalcemia. JOHN B. MCANENY, M.D.

Polyostotic Fibrous Dysplasia. D. K. O'Donovan, F. Duff, T. D. O'Farrell, and John McGrath. Irish J. M. Sc., September 1944, pp. 498–504.

A case of polyostotic fibrous dysplasia in a 4 1/2-year-old girl is recorded. Though fairly typical, this case presented some unusual features, as retarded mental development, extensive lesions in the bones, predominance of cartilage in biopsy specimens of bone, and anemia with nucleated red cells in the peripheral blood. All the bones of the body showed slight decalcification and a lack of normal trabeculation, even in the absence of cyst-like formation. The differential diagnosis of the disease is discussed; roentgenograms are reproduced.

Sarcoidosis. Report of a Case. John A. Boone and Ralph R. Coleman. South. M. J. **37:** 477–481, September 1944.

A case of sarcoidosis in a 40-year-old Negro is presented. In addition to the typical lesions of the nose, ears, fingers, toes, and lymph nodes, this patient showed two other features of the disease: elevated plasma protein and eosinophilia. Although he had been exposed repeatedly to active tuberculosis, he gave a negative tuberculin reaction, and a thorough search of the lesions for tubercle bacilli was fruitless. Roentgenograms of the hands and feet revealed multiple involvement of the metacarpals, metatarsals, and phalanges, the lesions appearing as distinct coarsening of the trabeculae, with multiple cystic areas. In only one or two places was there any distinct bulging of the cortex. Some small cystic areas were seen in the carpal bones, none in the tarsal bones. Photographs and roentgenograms showing the lesions of the hands and feet are reproduced. X-ray examination of the chest, skull, long bones, and pelvis was negative.

Multiple Diffuse Fibrosarcoma of Bone. Paul E. Steiner. Am. J. Path. **20:** 877–893, September 1944.

A case of multiple diffuse fibrosarcoma of the bone in a 43-year-old male is reported. This tumor was studied by a number of experienced American and European bone pathologists, none of whom had ever seen a similar growth.

Except for dryness and scaling of the skin of the extremities, the patient was well until 1934, when he began to have pain in his back. There was no history of trauma. He continued to work as a coal passer on the railroad until December 1935, when the pain became too severe for him to continue. He entered the hospital on Jan. 16, 1936. The pain was chiefly lumbar, continuous, did not radiate, and was worse at night and on motion. The back appeared normal. The left leg was shorter than the right and the pelvis was tilted. The left knee jerk was increased. The left testicle was atrophic. An ichthyosis of the skin of the arms and back was present. A lateral roentgenogram of the lumbar vertebrae showed no evidence of fracture, dislocation, demineralization, or other bone abnormality. Fluoroscopic examination of the chest was normal. Studies of the alimentary tract were negative except for ptosis of the transverse colon. Laboratory findings were normal. The diagnosis at this time was possible beginning of Paget's disease.

The patient continued to have severe pain in the lower dorsal and lumbar regions, unrelieved by removal of his teeth, traction, or by drugs. The dorsal and lumbar spine became fixed and there was a kyphos in the region of the 8th dorsal vertebra. On July 29, roentgen studies showed "a destructive process involving the bodies of the 4th, 5th, 6th, and 9th thoracic vertebrae and the 1st lumbar vertebral body; also the transverse processes; the 12th rib on the left side and the 11th right rib, suggestive of malignancy." There was a mottled appearance of the pelvis suggestive of atrophic change.

In August, two small nodules appeared on the ribs, and in September non-traumatic fractures of the 6th, 7th, and 8th ribs were observed. Numbness to the level of the knees also developed in September. The patient had a severe progressive anemia, poor appetite, and frequent emeses. He died Oct. 30, 1936. He had received no x-ray or radium therapy. The final clinical impression was malignant tumor metastatic to bone, with the primary site undetermined. Autopsy findings are given in detail and postmortem roentgenograms are reproduced.

This case was one of osteolytic fibrosarcoma of bone in which the lesions appeared at approximately the same time in many bones, and in which the tumors, although highly infiltrative, retained the normal configuration of the bones. Nowhere was there any considerable mass or enlargement suggestive of a primary site of origin. The distribution and extent of the sarcoma were those of the hemopoietic and reticuloendothelial areas in the skeleton. There were small metastases in many viscera. Two views about the

nature of this tumor present themselves. One is that it represents widespread sarcomatous change in Paget's disease. The other is that it is a peculiar fibrosarcoma probably arising from the medulla of bone and possibly multicentric in origin, and thus related to the myelomas, which it resembled in its distribution and behavior. The author favors the latter theory.

Ossifying Fibroma of the Superior Maxilla. H. James Hara. Arch. Otolaryng. **40:** 180–188, September 1944.

Three cases of ossifying fibroma of the superior maxilla, occurring in women aged 20 and 29 and in a boy of 14, are reported. This tumor is slow growing and usually unilateral. The site may be in the anterolateral process, with eventual obliteration of the canine fossa and possible invasion of the adjacent portion of the malar bone. Outward expansion on the buccal surface results in a characteristic facial deformity. In other patients the tumor invades the hard palate, occasionally causing dysphagia. There is no tendency to metastasize, and malignant change has not been recorded. The teeth overlying the tumor may be healthy or they may be carious; they are usually irregular and crowded. The soft tissue over the growth is smooth and avascular, but the tumor feels hard and unyielding.

Roentgenography is a distinct aid in diagnosis. It is of assistance in distinguishing the cancerous bone-forming tumor from the non-cancerous one. The contour of the non-cancerous tumor is always smooth; the cancerous growth tends to infiltrate. Two distinct types of ossifying fibroma may be recognized roentgenologically—the circumscribed and the diffuse. The maxilla is enlarged. The cortex is thinned. There is no periosteal reaction. In all of the present series the lower half of the affected maxillary sinus appeared diffusely clouded. A small area of rarefaction above the site of the tumor suggested the presence of air. The mucosal lining was intact. According to Worth (Brit. J. Radiol. **10:** 223, 1937), the growth occurring in younger patients casts a homogeneous but soft shadow on the film, presenting a stippled appearance not unlike that of the rind of an orange; in older patients, a dense ground-glass shadow, appearing much harder and structureless.

Two of the tumors in this series were well circumscribed; the third was diffuse. The circumscribed tumors were completely resected. The diffuse tumor was curetted sufficiently to give its bony bed a normal contour. No attempts were made to remove the portion which infiltrated the dental roots.

Capillary Hemangioma of Bone (Case Report). Mary S. Sherman. Arch. Path. **38:** 158–161, September 1944.

Approximately 60 cases of hemangioma of the bone, not all well confirmed, have been recorded. In two-thirds of these cases the tumor was located either in the spine or in the skull; in one-fourth, in the long bones; in 2 cases, in the pelvis; in 2, in the tarsal bones; in 1, in the scapula. The pathologic observations in almost all of these cases are similar, being those of typical cavernous hemangioma. Among all the varied reports, there are only 4 cases in which the hemangioma was thought to be of the capillary type. A fifth case of this type is presented.

A one-month-old girl was first brought to the clinic because of a swelling of the left knee, which had been observed since a few days after birth. Examination showed the circumference of the left knee to be 1 cm. greater than the right. A roentgenogram at eight weeks revealed no lesion of bone but a definite soft-tissue swelling. The swelling gradually decreased, and by the time the child was five months old, there was "only a slight dimpling at the site of the former sclerema." When the patient was eighteen months old she was brought back because she "slapped" her left foot as she walked. The left knee was then 2 cm. greater in circumference and the extremity 1 cm. longer than the right. Five months later the child complained of occasional pain in the knee, and a slight flexion contracture developed. The relative dimensions of the extremities had not changed and there was no abnormality on auscultation over the femoral vessels, but x-ray examination disclosed an area of radiolucency in the anterior portion of the lower part of the femur and periosteal elevation for about 6 cm. up from the epiphysial line.

When the patient was two years and four months old, more sclerosis and more periosteal new bone were visible on the roentgenogram. With a preoperative diagnosis of osteomyelitis, the lesion was explored. Organized periosteal new bone was encountered for some 5 cm. up from the epiphyseal plate. The cortex was thickened over a slightly greater area, and the medullary cavity was full of sclerotic cancellous bone. As much of this as could be removed without danger of predisposing to fracture or to arrest of growth was curetted out. Anteriorly several pockets of fibrous tissue were removed. No pus was found, and the wound healed by primary intention. Sections of the material removed showed the lesion to have been a capillary hemangioma.

Eighteen months after operation, the patient was asymptomatic and the roentgenogram showed the defect in the femur to be healed. Six months later she had a brief return of pain and tenderness, subsiding spontaneously and unaccompanied by physical or roentgenographic changes. In July 1944, four and one-half years after operation, the patient had been completely free of pain for twenty-three months. There was still 1.5 cm. difference in the length of the legs, due to overgrowth of the left femur.

The histologic picture, the history of symptoms since birth, the relief of symptoms by operation in which the lesion was incompletely excised, and the fact that there was no recurrence or spread confirm the impression of a congenital capillary hemangioma, primary in the lower part of the femur, undergoing fibrous regression or "sclerosis."

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography, a Routine Aid in Gynecological Diagnosis. Phineas Bernstein. Am. J. Obst. & Gynec. **48:** 189–199, August 1944.

For visualization of the female genital tract, the use of a new opaque medium, Viscorayopake, is recommended. Non-toxic, quickly absorbed, chemically stable, and amply viscous, it is easily administered and does not gel or crystallize at room temperature. The technic is simple and safe, and undesirable side effects are minimal.

The patient is given 2 drams of licorice powder the

night before and an enema on the morning of the test. A preliminary bimanual examination is performed to determine the cervico-uterine angle (for direction of the canal) and the fundal size (for estimation of its capacity). The medium is introduced by means of a 20-c.c. syringe fitted by a Luer metal tip to a uterine stem cannula with perforated end, as used in the Rubin insufflation test, or to a Colvin stainless steel screw-tip cannula. Upward pressure of the syringe piston displaces air from the syringe and its contained opaque fluid. If the medium injected into the uterine cavity contains air bubbles, errors in diagnosis are prone to occur. The cannula is then cautiously inserted through the external os, following the line of the cervico-uterine axis, until the perforated tip lies within the cavity.

For roentgenography the factors used ordinarily, for a 20 cm. body thickness, are: 50 ma., 58 primary volts, a two-second exposure, and a focal plate distance 30 to 36 in. A scout film is first taken. This often reveals calcified lymph nodes, phleboliths, or unabsorbed lipiodol used in previous tests, and is of value in excluding misleading shadows. After each 2 c.c. of radiopaque fluid has been injected, films are taken until 6 or 8 c.c. of Viscorayopake and four or five x-ray films have been used. The fluid contents of the uterine cavity may then be removed by withdrawing the piston.

The syringe is disconnected from the cannula, and about 10 to 15 c.c. of CO_2 gas, from a clean syringe, is injected into the uterine cavity. Another plate is taken while piston pressure is maintained. Hysteroaerography delineates cavity and tumor outlines by contrast of the gas with the Viscorayopake film adherent to the uterine wall.

Enlarged uterine cavities or tubal dilatations sometimes require up to 15 c.c. of opaque medium.

The alteration in size and contour of the uterine shadow indicates not only the extent and location of new growths, but also identifies the type of tumor by means of characteristic and representative patterns. Salpingography serves both to differentiate between uterine and ovarian tumors and between abdominal tumors and those of pelvic origin. It is also useful in determining the structural status of the fallopian tube in patients undergoing treatment for sterility.

Contraindications to hysterosalpingography are acute pelvic disease, gonorrhea, intrauterine or ectopic pregnancy, cervical carcinoma or infection, and epilepsy.

Thirty-eight women were examined roentgenographically in the course of sterility studies after insufflation by the Rubin technic. Infantile uterus was observed twice, as were bicornuate uterus and ovarian cyst. Eight patients had tubes which, although patent, showed marked curling, dilatation, or partial obstruction due probably to peritubal adhesions. Patency of one or both tubes was demonstrated 27 times. In 15 instances both tubes were open, but in 8 of these cases there were varying degrees of kinking and dilatation. In 12 patients only one tube was visualized as patent. Bilateral closure occurred at the fimbriated portion in 3 instances, centrally in 2, and proximally, at the uterotubal junction, in 6.

Fourteen patients were examined for other complaints than sterility. In this group were 6 fibroids, 4 ovarian tumors, 2 cases of hydrosalpinx, a uterine polyp, and a multiple carcinoma of the uterus and tube. Most of these lesions were previously diagnosed, but in each instance further information was obtained by roentgen study. The stereoscopic technic proved valuable in determining not only the exact position but also the relative size of the tumors.

Constant x-ray evidence of tubal closure was obtained in three pregnant patients and may indicate that a uterotubal sphincter spasm occurs physiologically in the gestational state.

The findings are statistically presented, with numerous reproductions of x-ray films. The article merits further study by those interested in employing this procedure. STEPHEN N. TAGER, M.D.

THE GENITO-URINARY TRACT

Renal Calculus with Parathyroid Adenoma. Gordon S. Foulds. J. Urol. **52:** 180–183, September 1944.

The author reports a case of multiple renal calculi attributable to hyperparathyroidism. He impresses the reader with the importance of a more thorough study of patients with recurring kidney stones.

A 22-year-old woman was first seen in 1928 with a right ureteral stone. At frequent intervals thereafter stones were removed from both sides of the urinary tract either by manipulation or operation.

In January 1936, parathyroid adenoma was suspected, but though the blood calcium was slightly elevated, a normal blood phosphate level, the oxalate composition of the stones removed, and the lack of calcium withdrawal from the bones, as shown by x-ray, caused this diagnosis to be temporarily abandoned.

Eight years later, in December 1943, the patient was admitted to the hospital with bilateral renal calculi, bone pain, fatigue, weakness, elevated blood calcium, decreased blood phosphorus levels, and x-ray evidence of osteitis fibrosa cystica. This picture, with biopsy evidence of fibrocystic disease of the left ilium, led to a diagnosis of hyperparathyroidism and in January 1944 a parathyroid adenoma was removed. After a somewhat stormy convalescence and treatment with parathyroid hormones and calcium, the patient was discharged in March 1944. She was practically free from pain and gaining strength. No change had taken place in the bones or in the renal calculi.

N. P. SALNER, M.D.

Extrarenal Tuberculous Lesions Associated with Renal Tuberculosis. D. S. Cristol and L. F. Greene. New England J. Med. **231:** 419–420, Sept. 21, 1944.

In the diagnosis of renal tuberculosis, a suspicion of the disease plays a large part, and any factor that will increase such a suspicion is welcome.

The authors have found that calcified mesenteric lymph nodes occur twice as frequently in renal tuberculosis as in a control group.

Of 81 males with renal tuberculosis, 34 (42 per cent) had genital tuberculosis, 31 had tuberculous epididymitis, and 3 tuberculous prostatitis. The presence of tuberculous epididymitis highly suggests renal tuberculosis, and in the presence of the latter disease, the genitalia of male patients should be examined for tuberculosis.

The healed or active adult type of pulmonary tuberculosis was found to occur in 34 per cent of the cases of renal tuberculosis as compared with 4 per cent in a control group. The healed childhood type of pulmonary tuberculosis occurred in 14 per cent of both the renal tuberculosis group and the control group.

JOHN B. MCANENY, M.D.

Case of Congenital Absence of a Kidney. Gustavo Cardelle, J. García Romeu, and J. García Rivera. Bol. de la Soc. cubana de pediat. **16:** 363–367, September 1944.

A 10-year-old colored girl was brought to the hospital because of continuous fever of twenty days' duration. In a routine clinical examination, the only significant finding was a tumor-like mass in the right upper abdomen. Retrograde pyelography following the routine laboratory examination revealed no ureteral opening in the bladder on the left. Through a very small right ureteral opening a catheter was inserted and a retrograde pyelogram was obtained, demonstrating clearly the hollow portion of the right kidney. Intravenous pyelography a few days later again indicated absence of the left kidney.

It is the opinion of the authors that a solitary kidney is of relatively frequent occurrence. The ureter is usually absent, also, although it may be present in rudimentary form.

Campbell, reviewing an autopsy series, reported the absence of one kidney once in 1,610 cases; in children, the absence was a little more frequent, once in 1,575. The left kidney was found to be absent about twice as often as the right. A. MAYORAL, M.D.

Renal Hydrocele: Subcapsular Renal Extravasation. Louis H. Baretz. J. Urol. **52:** 184–198, September 1944.

In this paper, the author discusses a condition which has been reported in the United States only a few times previously, namely renal hydrocele. This consists in the extravasation of urine beneath the true renal capsule, so that the kidney is almost completely enveloped by a cyst or sac lined parietally by capsule. Crabtree (Tr. Am. A. Genito-Urin. Surgeons **28:** 9, 1935) is quoted as setting forth the following factors necessary to the condition: trauma which opens the renal pelvis or a calyx; maintenance of the opening beyond the healing period; acquired or pre-existing hydronephrosis. The author adds another, slow extravasation beneath an uninjured capsule.

Symptoms and signs are an enlarging mass in the kidney region, increasing abdominal discomfort, and decreasing urinary output. Retrograde pyelography may show passage of the opaque medium from the renal pelvis to a surrounding sac. Early operation is indicated. It is not always necessary to sacrifice the kidney.

The author reports a case presumably occurring late in the course of pregnancy. A small abdominal mass was first observed three days postpartum, though the fact that the possibility of a twin pregnancy had been entertained indicates that the mass may have been present earlier. By the fourteenth day postpartum, it was shown roentgenographically to occupy the entire left upper abdomen, extending across the mid-line to the right and displacing the stomach and intestines. It continued to increase daily in size, and pain was persistent. A diagnosis of possible polycystic kidney was made, and operation was undertaken. The mass was incised and 6,000 c.c. of cloudy, purulent urine were evacuated, and a portion of the sac wall was removed for microscopic study. The diagnosis was subcapsular extravasation or renal hydrocele. A left pyelogram made twenty-three days after operation showed an elongation of the superior calyx and distortion of its minor calices. The dye was seen to extravasate through the superior calyx and pool in a large cavity which was interpreted as a cystic space or locule where the capsule had not completely separated from the kidney. This was apparently filled with urine and pus. The kidney wound was opened and the locule drained, following which recovery was complete.

On questioning, the patient recalled a slight blow to the left side about a week before hospital admission. This had caused momentary pain but had promptly been forgotten. The author believes that complete subcapsular extravasation did not occur immediately, as the pregnant uterus, by direct pressure upon the kidney, may have acted by tamponage to prevent urinary leakage. Following delivery, this pressure was relieved and the tear from calyx to capsule allowed free extravasation. The pre-existence of a dilatation of the renal pelvis and calices is assumed, as this is of common occurrence in the later months of pregnancy. This, followed by trauma to produce the required slow leakage, completed the necessary factors for renal hydrocele. EDWIN L. LAME, M.D.

Non-Fibrous Vesico-Ureteral Obstruction. James F. McCahey and John S. Fetter. J. Urol. **52:** 216–223, September 1944.

Obstruction in the intramural portion of the ureter in the absence of fibrous constriction is not generally admitted at present. Hunner (in Cabot's *Modern Urology*, 1924, Vol. 2, p. 255) has described ureteral stricture of large caliber, but this conception has not been favorably received by urologists. Current urologic practice is to assume that if there is no impediment to the passage of a ureteral catheter upward, there is no hindrance to the flow of urine downward. The purpose of this paper is to show that vesico-ureteral obstruction may exist without an organized stricture.

Four cases of renal colic and one of hematuria are presented. All are believed to be examples of non-fibrous vesico-ureteral obstruction. Ureteral catheterization disclosed no obstruction in these cases, but intravenous urography revealed dilatation of the ureter, or pelvis and calices, or the entire upper urinary tract. Catheterization and dilatation of the involved ureter resulted in cessation of symptoms and improvement in the roentgenographic appearance after intravenous urography. Reproductions of urograms from 4 of the cases are included.

The authors believe that diagnosis of stricture of the free portion of the ureter should not be based solely on the appearance of narrowed areas in intravenous urographic films, without a supplementary retrograde study. One of the cases is cited to demonstrate that ureteral dilatation does not necessarily mean ureteral atony. If the latter can be prevented by proper management, life may be prolonged.

The following conclusions are reached:

The fact that ureteral catheterization offers no difficulty is not proof that obstruction does not exist at the vesical end of the ureter.

Non-fibrous vesico-ureteral obstruction should be considered whenever suspicion of obstruction is justified by the urologic findings.

Continued dilatation may be necessary in some instances of vesico-ureteral obstruction.

Proper management may be not only pain-relieving but life-prolonging. CHARLES R. PERRYMAN, M.D.

Primary Neoplasms of the Ureters: Report of Six Cases. Roger W. Barnes and George K. Kawaichi. Urol. & Cutan. Rev. **48:** 430–436, September 1944.

Hematuria, the most common symptom of ureteral tumor, was present in all 6 cases of ureteral neoplasm reported by the authors. Pain was the second most common symptom and was present in 4 cases. One patient had a severe renal infection proximal to the tumor; one had burning on urination, and another loss of weight.

Cystoscopic examination revealed no renal function in 5 cases and reduced renal function in 1. Obstruction to the ureteral catheter at the tumor level was present in 5 cases. Hydronephrosis and hydroureter were invariably present, but in varying degrees. A ureteral filling defect was demonstrated in 4 cases. In another case, diagnosis was not made until four years following a nephrectomy, when cystoscopy revealed a tumor protruding from the ureteral orifice. Diagnosis in a sixth case was based on evidence of ureteral obstruction at cystoscopy and irregularity of the lower edge with no evidence of dye proximal to the tumor in the ureterograms.

Ureteral tumors should be considered in all patients with hematuria. Diagnosis is contingent on good pyeloureterograms, and demonstration of the entire ureter is essential. Filling defects due to tumors of the ureter show encroachment upon the lumen, with shaggy, irregular margins. Extraureteral pressure defects are more likely to be feather-edged, and ureteral strictures are conical. A filling defect over the promontorium may be due to incomplete distention of the ureters and is the result of pressure by the bony prominence.

Treatment is one-stage combined nephro-ureterectomy. The authors believe that even benign lesions are potentially malignant and should be treated as such. Six cases are reported in detail, with excellent reproductions of the pyelo-ureterograms.

MAURICE D. SACHS, M.D.

THE BLOOD VESSELS

Aneurysm of the Renal Artery—True and False—with Special Reference to Preoperative Diagnosis. Joseph A. Lazarus and Morris S. Marks. J. Urol. **52:** 199–215, September 1944.

The authors present a case of aneurysm of the renal artery diagnosed preoperatively and summarize 74 previously reported cases, listing for each case the sex, age, location, history, symptoms, signs, treatment, results, and operative or autopsy findings. Etiological factors include trauma (in 34.7 per cent of the cases), severe debilitating infections which may weaken the walls of the arteries, and atherosclerosis, which was generalized in only 10 of the cases. Syphilis was present in only 3 cases.

Aneurysms are of the true or false type. A true aneurysm is a saccular dilatation of an artery containing all elements of the arterial wall. A false aneurysm is a saccular dilatation due to trauma resulting in complete disruption of continuity of the arterial wall, either in part or in its entirety, in which the limiting wall from without inward consists of adventitia, laminated blood clot, and endothelium, the last being an ingrowth from the injured artery. Mild trauma may contuse an arterial wall but not break its continuity. Weeks or months later the area will stretch or bulge, producing a sacciform type of arterial aneurysm, or the wall may rupture and form a false aneurysm.

Symptoms depend upon the size of the aneurysm, its location, and whether or not rupture has occurred. Small aneurysms may be symptomless, while larger aneurysms produce symptoms, the most common of which is pain in the loin. There was a palpable mass present in 30 per cent of the cases. On x-ray examination, an opaque ring shadow with a dense periphery in the region of the renal pelvis is suggestive but not pathognomonic. Dos Santos, by injecting 15–20 c.c. of a 10 per cent sodium iodide solution directly into the aorta, claims to have obtained characteristic arteriograms in cases of suspected aneurysm of the renal artery.

Treatment consists of immediate nephrectomy with ligation of the renal artery proximal to the point of origin of the aneurysm.

The aneurysm in the authors' case was associated with calculous pyonephrosis, and a correct preoperative diagnosis was made by finding the typical ring shadow on the x-ray film in the region of the renal pelvis. Owing to the location of the aneurysm, the lesion was missed at operation but was clearly disclosed on pathological examination of the extirpated kidney.

DAVID KIRSH, M.D.

Roentgenologic Observations in Mesenteric Thrombosis. Richard A. Rendich and Leo A. Harrington. Am. J. Roentgenol. **52:** 317–322, September 1944.

Three proved cases of mesenteric thrombosis are reported, in which the most striking roentgen finding was localized distention of the intestine simulating a mechanical obstruction but having a distribution which corresponded to that of the superior mesenteric artery, with an abrupt demarcation of the distended intestine near the splenic flexure of the colon. In one case a barium enema passed freely through the distended intestine showing that no mechanical obstruction was present. One patient died. The other two made a complete recovery after bowel resection.

The general causes of mesenteric thrombosis have been classified as cardiovascular, infectious, mechanical, and traumatic. Occlusion of the superior mesenteric artery is said to be forty times more frequent than blocking of the inferior mesenteric artery. Abdominal distention is a common feature. A review of the literature reveals that roentgen examination of the abdomen in this condition is infrequent. The possible diagnosis of thrombosis of the superior mesenteric vessels should be among those considered when the plain roentgenogram of the abdomen discloses bowel dilated down to the region of the splenic flexure.

Three cases are described in detail and reproductions of roentgenograms are included.

CLARENCE E. WEAVER, M.D.

FOREIGN BODIES

Direct Visual Guidance, Triangulation Roentgenoscopy in the Removal of Opaque Foreign Bodies. Wendell E. Roberts. Am. J. Roentgenol. **52:** 327–331, September 1944.

The author has designed a fluoroscope in which two roentgen tubes are mounted in parallel. One tube is so set that rays are at right angles to the table top and the other is tilted slightly so that the rays intersect

those of the first tube for triangulation roentgenoscopy. The two tubes are activated simultaneously through a foot switch, and the radiation from both is projected through the same shutter assembly. Two shadows of the opaque foreign body and the forceps or probe are thus thrown on the fluoroscopic screen. If the two instrument shadows are to the right of the foreign body shadows the instrument is too far to the right, though it may be in the proper horizontal plane. The same is true to the left. If the instrument is placed too far posteriorly (toward the table top) the two shadows of the instrument will be farther apart on the fluoroscopic screen than the two shadows of the foreign body. If the instrument is introduced too far anteriorly, the instrument is farther from the tubes than the foreign body and the two shadows of the instrument will be closer together than the shadows of the foreign body. When the instrument is introduced into the proper plane and neither to the right nor left, the shadows of the foreign body and the instrument are in direct apposition in both images on the screen.

For foreign bodies in the eye, the patient must be placed on his side on the roentgenoscopic table. All that is necessary is to decide the nomenclature of the directions so that the surgeon will understand the directions given by the roentgenoscopist.

No measurements are needed in this method. Only a glance at the fluoroscopic screen is necessary to determine the position of the surgeon's instrument in regard to the foreign body.

Illustrations show the various positions of shadows of the foreign body and instrument with the latter placed correctly and incorrectly in relation to the former.

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RADIOTHERAPY

Hemangioma of the Adult and of the Infant Larynx. A Review of the Literature and a Report of Two Cases. George B. Ferguson. Arch. Otolaryng. **40:** 189–195, September 1944.

One hundred and twenty-three cases of hemangioma of the larynx have been recorded in the literature. Two distinct classes have been described: the adult cases, numbering 115, and the infantile, numbering 7. One new case in each group is here reported.

Entirely different sets of symptoms characterize the infantile and adult forms of hemangioma. Because of the subglottic position of the infantile form, a slight infection of the upper respiratory tract is often sufficient to cause symptoms of respiratory distress. Wheezing and labored respiration quite similar to that seen in streptococcic laryngitis are present. The signs of acute infection, however, are not so prominent; the fever is not so high, nor are the local signs of an infection of the throat so marked. The presence of hemangiomatous involvement of other areas of the body should arouse suspicion; in 3 of the 8 reported cases there was such involvement. Lateral roentgenograms may show a discrete tumor in the subglottic larynx. In 3 of the 8 cases of infantile hemangioma the diagnosis was made only at autopsy, and in 2 additional instances autopsy confirmed the diagnosis.

In the adult type of laryngeal hemangioma the symptoms are often vague and of extremely long duration. Hoarseness, followed by cough, dyspnea, hemoptysis, and dysphagia, is common. The tumor as seen through a laryngeal mirror may be small or extremely large. It is usually described as somewhat resembling a raspberry, irregular in contour and purplish in color, though it may be red, pink, or occasionally white. Ulceration is rarely observed. The tumor is usually attached by a broad base to the underlying structures; in certain cases it may arise from a delicate pedicle.

Relief of dyspnea often becomes an urgent necessity in cases of laryngeal hemangioma of the infantile type. Tracheotomy, performed as low as possible to avoid cutting the tumor, is the best procedure in the opinion of most observers. Lateral roentgenograms of the neck, taken for soft-tissue detail, may give definite information concerning the size and extent of the tumor prior to tracheotomy. Roentgen radiation or radium, cautiously used to avoid perichondritis, usually produces a rapid decrease in the size of the tumor. Roentgen therapy, consisting of six treatments to alternate sides of the neck, of 100 r each, with 0.4 mm. tin plus 1.0 mm. copper filtration, proved entirely satisfactory in reducing the tumor in the author's case. One year elapsed between tracheotomy and roentgen therapy. If tracheotomy has not been done as a preliminary step, the patient should be closely watched for an increase of dyspnea during the period of irradiation. He should be kept in a hospital where facilities for emergency tracheotomy are instantly available. Failure to respond to irradiation may make thyrotomy necessary.

A small tumor of the adult type may be removed through the laryngoscope by means of seizing or cutting forceps. Profuse hemorrhage is unlikely, and recurrence is rare. Fatal hemorrhage has occurred, however, and is especially to be feared when the tumor is large, particularly if it is attached by a fairly broad base. Such a tumor is best treated by coagulation with surgical diathermy or by irradiation with radon implants, radium needles, or roentgen rays. If the pedicle is easily reached through the laryngoscope, a suture may be passed through the base of the tumor, which may then be excised above this level. Larger tumors demand careful selection of approach, which may be through the mouth, by laryngofissure, or by lateral pharyngotomy.

Roentgenograms are reproduced.

Tumors of the Urogenital Tract in the Young. Clarence G. Bandler and Philip R. Roen. Am. J. Surg. **65:** 306–314, September 1944.

During the past two decades, 43 cases of malignant tumor of the urogenital tract in children have been seen at the New York Post-Graduate Hospital. In this group according to the authors' tabulation, were 32 renal tumors, 3 tumors of the adrenal, 4 tumors of the bladder, and 4 tumors of the testis. [Since only 2 testicular tumors are mentioned in the text, it may be that the total should be 41 instead of 43.]

Of the 32 renal neoplasms, 31 were Wilms' tumors; the remaining tumor, diagnosed preoperatively as Wilms' tumor, in a boy of six and a half, was found on pathological examination to be a papillary carcinoma of the kidney. Wilms' tumor has been called a disease of signs rather than symptoms. The presenting complaint

in the vast majority of cases is a gradual enlargement of the abdomen. Hematuria was present in only 3 per cent of the cases in this series. The mass in most instances is smooth to palpation and has a mobility depending on its size. It characteristically grows downward, forward, and across the abdomen toward the opposite side rather than bulging in the flank as do renal tumors in the adult.

Diagnosis of Wilms' tumor can usually be made by intravenous urography. This shows not only displacement of the affected kidney and distortion of the pelvis but also delineates the opposite kidney and reveals whether it is functionally sound. In some cases, retrograde urography may be necessary. Differential diagnosis calls for consideration of suprarenal tumors, renal cysts, hydronephrosis, ovarian and hepatic tumors, splenomegaly, and retroperitoneal sarcoma. Aspiration biopsy is condemned.

Preoperative and postoperative x-ray therapy should be given. The preoperative radiation in many cases reduces the size of the mass and increases its mobility. This should be administered through several portals in fractionated doses rather than in a single massive dose, with adequate protection of vital organs. Surgical removal of the tumor is probably best performed five or six weeks after completion of the roentgen irradiation. The transperitoneal approach is favored. Postoperative irradiation should be started about one month after nephrectomy. If metastases are present or are found later, intensive irradiation should be given to the involved sites.

The prognosis in Wilms' tumor is poor. Among the 24 cases followed there were only 2 postoperative survivals at the time of the report: one for two months and the other for three years.

The 3 adrenal tumors in the authors' series were neuroblastomas. This tumor grows rapidly, protrudes posteriorly in the flank, and may require differentiation from renal tumor. Urograms show a downward displacement of the kidney, with less distortion of the pelvis than is seen with Wilms' tumor; frequently exact differentiation is difficult and the true character of the disease may be discovered only at operation. Unfortunately, in most instances, metastases are already present when the abdominal tumor first becomes apparent. In the authors' cases, metastases were widespread at the time the children were first seen. These metastatic lesions take two forms, distinguishable clinically: (1) the Pepper type, consisting in extensive metastases to the liver producing marked abdominal enlargement with pain, nausea, vomiting, and cachexia; (2) the Hutchison syndrome, characterized by early orbital and skeletal masses with consequent swelling about the bones of the skull, proptosis of the eye, and profound anemia. In either type, the course is rapidly fatal and death occurs within a few months.

Vesical tumors are unusual in children; of the 4 cases in this series, 2 were sarcomas, 1 a small papilloma, and the fourth multiple papillomas. Papillomas, although microscopic examination may show them to be benign, are potentially malignant, if only in their tendency to local recurrence.

The 2 testicular tumors occurred in boys aged one year and eight months and twelve and one-half years, respectively. The pathological diagnosis in each instance was teratoma. Palpation of a hard, enlarged scrotal organ should suggest the diagnosis. Aspiration biopsy of the testicular growth is not recommended. The Aschheim-Zondek test is an important diagnostic aid. Before metastasis has occurred, treatment should include preoperative x-ray irradiation and orchiectomy. In those cases in which lymphatic or hematogenous spread is present, only radiation therapy of the primary mass and the secondary implants is advised.

Early diagnosis of malignant neoplasms of the genitourinary tract in children is necessary for successful therapy. In all cases, treatment should be by x-ray radiation and surgery combined; radiation therapy alone should be employed only in those cases in which widespread metastases are present.

Prostatic Carcinoma: Endocrine, Roentgenologic, and Surgical Treatment. Henry K. Sangree. Pennsylvania M. J. **47:** 1213–1215, September 1944.

The author reports a series of 20 cases of prostatic carcinoma—10 adenocarcinomas, 1 squamous-cell carcinoma with malignant epithelial cells, and 9 undifferentiated carcinomas. Sixteen of the patients were over sixty years of age. The youngest—the patient with the squamous-cell carcinoma—was only eighteen. He died after two months, with pulmonary metastases, in spite of surgery and intensive deep x-ray therapy. Only 3 patients survived beyond five years. The author believes that the best results are obtained with suprapubic prostatectomy, bilateral orchiectomy, irradiation, and diethylstilbestrol, but considers the type of carcinoma of greater prognostic significance than any single therapeutic method.

A modified Pilcher bag is described having four holes bored in the center so that radium needles can be placed in them when the bag is introduced postoperatively for hemostasis and removed when necessary, without disturbing the bag.

Carcinoma in Young Persons. Robert P. Morehead. Arch. Path. **38:** 141–145, September 1944.

The author discusses the occurrence of carcinoma in young persons and reports 2 cases of carcinoma of the liver, one in a boy of thirteen and the other in a youth of eighteen; 2 cases of carcinoma of the cervix, in patients nineteen and twenty years of age; and 3 cases of carcinoma of the body of the uterus, in women under the age of thirty.

Pseudocarcinomatous Hyperplasia in Primary, Secondary and Tertiary Cutaneous Syphilis. Herbert Lawrence. Arch. Path. **38:** 128–131, September 1944.

Pseudocarcinomatous hyperplasia superimposed on a gumma is frequently treated as carcinoma instead of syphilis. Extragenital primary syphilis with pseudocarcinomatous hyperplasia may also be confused with carcinoma, particularly because of the frequency with which the former occurs at carcinoma-bearing sites. Occasionally a solitary lesion of late secondary syphilis or of precocious benign tertiary syphilis presents a problem in diagnosis. Too frequently a carcinomatous-looking lesion of the skin or the mucous membrane is removed surgically or irradiated without the possibility of syphilis entering the clinician's mind and without a serologic test for syphilis being performed. The omission is particularly serious in the presence of a lesion of the face, lip, tongue, vulva, or cervix.

Pseudocarcinomatous hyperplasia occurs in primary, secondary, and tertiary cutaneous syphilis. It is frequently difficult to distinguish histologically between

this hyperplasia and carcinoma, which would account for some of the reported "cures of cutaneous carcinoma" by antisyphilitic therapy. An adequate history of the case and a report of a serologic test for syphilis should accompany the specimen to the pathologist.

Three cases are presented, illustrating pseudocarcinomatous hyperplasia occurring in primary, secondary, and tertiary cutaneous syphilis.

A New Nasopharyngeal Radium Applicator. M. William Clift. Arch. Otolaryng. **40:** 208–209, September 1944.

A new type of nasopharyngeal applicator for irradiation of the eustachian tube is described and illustrated. With this applicator the technic of insertion and withdrawal is simplified and discomfort to the patient is minimized. Its over-all length is 6 1/2 inches. It consists of four parts: a brass capsule, capable of holding five 10-mg. needles or a 50-mg. capsule of radium; a shaft of silver wire; a handle one inch in length with one surface flattened; a sliding stop which automatically locks at any position. This stop consists of a metal disk united to an ordinary tie pin clasp. When the applicator is inserted and the capsule rests in the proper position, the stop is moved along the shaft until it rests against the nose, where it locks, and is held in place by a strip of adhesive tape. Since lymphoid tissue may be distributed throughout the entire eustachian tube, it is desirable that the beta rays be absorbed by adequate filtration.